SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JUNE, 1932.

GENERAL PHYSICS.

1805. Accelerometer for Wheel-Impact Measurements. F. Aughtie. *Phys. Soc., Proc.* 44. *pp.* 31–44; *Disc.*, 49, *Jan.* 1, 1932.—The instrument was developed for the measurement of the acceleration of the rear axle of a vehicle. It is necessary for the recording to be done remotely in order accurately to phase three records, two of acceleration and one of spring load. A new method of remote recording has been developed for the purpose. The paper describes the design of the instrument, its principle of operation, and also, though briefly, the auxiliary equipment. The undamped natural frequency is 300 ∼ and the maximum reading is 25 *g*. Damping is provided by filling the casing with light mineral oil and, although less than critical, is sufficient to eliminate from the records any disturbance due to self-oscillation. AUTHOR.

1806. Load-Gauge for Wheel-Impact Measurements. F. Aughtie. *Phys. Soc., Proc.* 44. *pp.* 45–49; *Disc.*, 49, *Jan.* 1, 1932.—The paper is supplementary to the previous paper [see preceding Abstract] and describes the load-gauge designed for measuring that component of the wheel-load which arises from the sprung-weight. AUTHOR.

1807. Radii of Curvature of Knife Edges. G. Schmerwitz. *Zeits. f. Instrumentenk.* 52. *pp.* 1–14, *Jan.*, 1932.—The author uses a special form of balance beam built up of rectangular plates of uniform thickness which are cemented together with very thin layers of Canada balsam so that the position of the centre of gravity can easily be determined by calculation. The knife edge investigated is mounted on an ordinary theodolite stand, so that it lies in the main horizontal axis of the instrument, and can be rotated through measurable angles. It is shown how from the measurements the radius of curvature of the knife edge can be calculated, and a number of practical problems, relating to the use of knife edges in balances, pendulums and seismometers are dealt with. H. N. A.

1808. Density and Temperature Constants of Pendulums. M. Boriosi. *Accad. Sci. Torino, Atti*, 66. 1. *pp.* 37–47, 1930–1931.—The gravimetric pendulums, numbered 5, 6, 7 and 8, made by the Mioni brothers of Padua, were examined in 1928 to establish the coefficients of temperature and pressure. The method of procedure is described and mathematical details are given of the way in which the results were calculated. [See also following Abstract.] H. M. B.

1809. Determination of " g " at Turin. M. Boriosi. *Accad. Sci. Torino, Atti,* 66. 2–5. *pp.* 85–97, 1930–1931.—Calculations are made from observations obtained in July and Aug., 1928, for the acceleration due to gravity at Turin; the pendulums used are those mentioned in the preceding Abstract. The result is compared with those of other observers and indicates that of de Silva to be the most correct. A brief description is given of the determination of gravity acceleration at Aosta. H. M. B.

1810. Surface and Interfacial Tensions, with an Application to the Problem of the Plate Ridge. J. Satterly and L. H. Collingwood. *Roy. Soc. Canada, Trans.* 25. *Sect.III. pp.* 205–214, *May,* 1931.—The surface tensions and interfacial tensions against water of various organic liquids of different types, including carbon tetrachloride, toluene and quinoline, have been determined. A linear relationship exists between the interfacial tension and the work of adhesion, defined as the sum of the tension at the water-liquid interface and the surface tensions of water and the liquid. The interfacial tension increases, in a strictly linear manner, with rise of temperature, probably as a result of the increasing molecular orientation at the interface. The surface tension-temperature relationship is nearly linear for a number of liquids. No definite connection could be found between the weight of the plate ridge and the interfacial tensions and viscosities of the liquids. H. F. G.

1811. Drainage of a Vertical Wetted Plate, Shape of the Profile and Thickness of the Film. J. Satterly and L. H. Collingwood. *Roy. Soc. Canada, Trans.* 25. *Sect.III. pp.* 215–225, *May,* 1931.—Jeffrey's mathematical investigation [see Abstract 2995 (1930)] of the drainage of a vertical wetted plate, which is summarised, has been examined experimentally by measurements with glycerin and olive oil films on glass plates. It is shown theoretically that the film is of parabolic profile near the top of the wetted portion, and this result, together with Jeffrey's conclusions regarding the change with time of the distance from the top of the wetted portion and of the thickness of the film, has been confirmed. H. F. G.

1812. Surface Tension of Different Dilutions of Boys' Soap Solution. L. D. Mahajan. *Phil. Mag.* 12. *pp.* 954–959, *Nov.,* 1931.—Two methods were employed, that of the surface tension balance, and that of weighing a counted number of drops. A curve showing the surface tension for different dilutions indicates that it falls very rapidly as the amount of solution added to the water is increased from zero to 5·0 %; from 5·0 % to 15 % it falls comparatively slowly, and after 15 % further increase in the soap solution causes the surface tension to rise again, but very slowly. The minimum at 15 % dilution occurs when the quantity of sodium oleate, 0·375 %, is just sufficient to form a monolayer of particles on the surface of water. With less than this the surface tension of water, which is far greater than that of soap solutions, predominates. Boys' soap solution contains 2·5 % sodium oleate and 25 % glycerin. H. N. A.

1813. Capillary Rise of Liquids between Parallel Plates. K. Schultze. *Kolloid Zeits.* 57. *pp.* 277–285, *Dec.,* 1931.—If the capillary rise of water between parallel plates is measured with a falling meniscus, it does not correspond with the known equation $h = 2\sigma/asg$, in which σ is the surface tension, a the distance between the plates, s the specific gravity of the liquid, and g the gravity constant, if the width of the plates is not more than 2 mm. For widths between 2 and 0·4 mm., combined in any way, the capillary rise decreases steadily with the width of the plates, if the distance apart remains constant. If the widths of the two plates are unequal, that of the narrower is decisive. Plates of equal widths give higher values than a combination of one of them with a narrower plate. If the width of the plates is increased for a given distance apart, the increase in the liquid rise increases as this given distance apart is diminished. The maximum rise is reached the more rapidly, the greater the distance between the plates. T. H. P.

1814. Viscosity of Suspensions of Elongated Particles. R. Eisenschitz. *Zeits. f. phys. Chem.* 158. *Abt.A.* 1–2. *pp.* 78–90, *Dec.*, 1931.—Whereas the Einstein theory of the viscosity of dilute suspensions requires the viscosity to be independent of the size of the particles, experiment has shown that for colloidal solutions of elongated particles this is not the case. The particles behave as though they are of abnormal size, and it has been suggested that this is a result of their thermal movements or of solvation. The viscosity of such suspensions has been calculated theoretically, on the principle of the Einstein theory, but for ellipsoidal particles of which the effective volume is regarded as equal to the geometrical volume. The result shows that the viscosity is dependent on both the concentration and the particle size, and the postulate of an abnormal effective particle size is therefore unnecessary. The equation obtained is in good agreement with the measurements made by Staudinger and Nodzu with paraffin hydrocarbons. H. F. G.

1815. Motion Approximating to the Plane Radial Motion of Viscous Incompressible Liquids. A. Rosenblatt. *Acad. Polonaise Sci. et Lettres, Bull. No.* 6*A. pp.* 438–459, *June*, 1931. *In French.*—The mathematical theory of the spiral motion of viscous incompressible liquids investigated by Hamel (*Jahresbericht der Deutschen Mathematikervereinigung*, 1916, T.25) is developed. J. S. G. T.

1816. Theory of Non-Stationary Viscous Fluid Motion. F. K. G. Odqvist. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 22*A*. 28. [22 *pp*], 1932. *In German.*—Solution of the equations $\Delta u_i - \partial u_i/\partial t = \partial p/\partial x_i$, $(i = 1, 2, 3)$, and $\partial u_i/\partial x_i = 0$, subject to initial and boundary values of u_i, are investigated for a number of cases. J. S. G. T.

1817. Instability of a Surface of Discontinuity. L. Rosenhead. *Cambridge Phil. Soc., Proc.* 28. *pp.* 35–44, *Jan.*, 1932.—A purely mathematical attempt to obtain the dominant wave-length without explicitly introducing viscosity; although the equations do not yield the desired information they give certain new results together with most of the earlier results as special cases. H. F. G.

1818. Diffusion for the Infinite Plane Sheet. A. T. McKay. *Phys. Soc., Proc.* 44. *pp.* 17–24, *Jan.* 1, 1932.—The paper deals with a problem of diffusion of moisture into an infinite plane sheet of hygroscopic material, when subject to two different surface conditions. The method of treatment follows along the lines of a previous paper [see Abstract 9 (1931)]. Further, a method is developed whereby the diffusivity and surface constants can be evaluated from experimental data. In order to facilitate the practical application of the methods propounded to this and similar diffusion problems, tables have been specially calculated giving the first four roots of each of the four equations $\left.\begin{matrix}\tan\\ \cot\end{matrix}\right\} x = \pm x \,.\, \left.\begin{matrix}\tan\\ \cot\end{matrix}\right\} \lambda$. The particular design of these tables has been chosen to allow of ready interpolation. AUTHOR.

1819. Volume-Temperature-Pressure Relations for Non-Volatile Liquids. P. W. Bridgman. *Am. Acad., Proc.* 67. 1. *pp.* 1–27, *Jan.*, 1932.—Relative volume decrements of the following liquids are found by means of the sylphon [see Abstract 2146 (1931)] at temperatures 0°, 50° and 95° C., and up to pressures of 12,000 kg./mm.^{2} or the freezing pressure, whichever is lower, *viz.*, ethylene glycol, diethylene glycol, glycerin, tri-o-cresyl phosphate, tri-acetin, ethyl dibenzyl malonate, methyl oleate, eugenol, iso-octane and isoprene. For all these $(\partial^2 v/\partial T^2)_p$ is positive at low and negative at high pressure, the change of sign occurring at about 3000 kg./mm.^{2} $(\partial p/\partial T)_v$ is not a function of volume only. The most prominent deduction from the results is the low compressibility of the OH group, a substitution of this group in a molecule lowering the compressibility considerably. Glycerin, containing three such groups, is the least compressible of all liquids so far investigated. Only part of this effect is due to a rise in the critical temperature, which accompanies the substitution. The presence of an oxygen atom in the molecule appears to raise the compressibility. J. P. A.

1820. Organic Substances in High-Vacuum Work. M. v. Brandenstein and H. Klumb. *Phys. Zeits.* 33. *pp.* 88–93, *Jan.* 15, 1932. —It is highly desirable to be able to dispense with the use of mercury in high-vacuum work. The authors show that with simple air-cooled pumps using liquid air it is possible to use organic substances such as a mixture of 10 % of paraffin with *n*-butyldiphthalate, for the production of vacua of the order of 10^{-3} dyne per cm.^{2}; that such substances may be used in pre-vacuum vapour-blast pumps; and that solid substances, such as paraffin, may be used in high-vacuum pumps as driving substances. A suitable model of pump is described. A. D.

1821. Adhesion of Glue. M. F. Witherell. *J. Phys. Chem.* 35. *pp.* 3583–3595, *Dec.*, 1931.—The factors influencing the adhesion between glue and a high-grade alundum are determined and the conditions are given for the best possible adhesion between the two. Increased adhesion appears to result from a silicate treatment, either with or without sodium hydroxide. J. K.

1822. Elastically Supported Beams. P. Neményi. *Zeits. f. angew. Math. u. Mechanik*, 11. *pp.* 450–463, *Dec.*, 1931.—Attempts to pass by rigid mathematical methods from the case of a beam rigidly supported at one or more points to that of a beam supported over one or more areas by an elastic support, have been defeated by analytical difficulties. Progress is possible if Schwedler's hypothesis is accepted that the normal pressure exerted by the support is at each point proportional to its displacement, or $p = kw$ where k is a constant. A full summary of recent theoretical developments from this standpoint is given, with particular reference to engineering applications. Experiment shows that k varies widely for differently shaped beams and different foundations. The Schwedler principle, while unsound physically, has been widely adopted, and other approximations (as that of Wieghardt) are not superior in practice. The principle is probably inapplicable to earth foundations. An extensive Bibliography is provided. J. P. A.

1823. Buckling of Beams under Transverse Load. H. Grauers. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* **22A**. 22. [31 *pp*], 1932. *In German.*—The use of a system of moving rectangular coordinates is invoked to solve the problem of buckling of beams under transverse load for conditions more general than those so far considered. As examples, the following cases are analysed in detail: (1) the cantilever loaded at the free end, (2) the cantilever with one free end, but loaded uniformly throughout its length, (3) a beam loaded at the middle and supported in guides at each end to prevent tilting, but not flexure perpendicular to the load, (4) the same beam, but flexure at the ends also prevented. In every case, the load at which buckling occurs is found to be higher than that calculated by previous methods. [See following Abstract.] J. P. A.

1824. Buckling of Straight Rods by Impact. H. Grauers. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* **22A**. 26. [19 *pp*.], 1932. *In German.*—Analytical methods [see preceding Abstract] are applied to the study of the buckling of a vertical rod when subjected to longitudinal impact. General formulæ are derived, and the following cases then worked out in detail: (1) lower end of the beam clamped, the upper end free, (2) both ends supported without clamping, (3) lower end clamped, upper end supported, (4) both ends clamped. The impact is assumed to be incident on the upper end in each case. J. P. A.

1825. Buckling of a Cylindrical Shell under Torsion. K. Sezawa and K. Kubo. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 76. *pp*. 251–314, *Dec*., 1931.—With the aid of the work of Southwell and Skan [see Abstract 2000 (1924)] an approximate mathematical solution is obtained of the problem of buckling of a thin cylinder under torsion. An experimental test is devised, employing rubber cylinders of diameter 10 cm., lengths from 5 to 35 cm., and thicknesses 0·6 to 2·8 mm. The helical corrugations which appear when the cylinder is twisted are measured, and the results recorded graphically in great detail. The moment of the critical couple for buckling is found to be approximately three times that deduced from the theory, while for a short cylinder experiment and theory are in accord. Theoretical deductions respecting the inclination of the corrugations to the axis of the cylinder are also in general accord with experiment; the shorter the cylinder, the greater the inclination of the corrugations. J. P. A.

1826. Load and Temperature Stresses in Circular Flat Plates. H. L. M'Broom and C. M. Moir. *Roy. Techn. Coll. Glasgow, J.* 2. *pp*. 665–679, *Jan*., 1932.—A previous paper by W. Kerr [see Abstract 2073 (1930)] dealt, generally, with the close similarity of the equations for the direct stresses and the bending stresses in circular plates of uniform thickness. The parallelism of the stress equations was established for both loading and temperature conditions with the aim of providing two sets of general results in strict correspondence. In any particular application of the results it is necessary to select the appropriate coefficients for the conditions, and proceed to arithmetical solutions. It has been thought desirable to present illustrations of this procedure in order to display the scope and method of application. With this aim in view the paper here given deals with several unusual flat plate problems. It considers (i) a plate with uniform lateral pressure and a temperature drop through the metal varying with radius; (ii) a plate with a central zone of uniform pressure and temperature drop, and an outer zone with radial variation of both; (iii) a plate loaded laterally with uniform pressure with either free or fixed periphery and carried on a ring support placed for minimum stresses; (iv) a rotating disc with lateral pressure and rotational stresses and with transverse and radial heat flows. AUTHORS.

1827. Singular Values of the Critical Speeds of Rotating Shafts. P. E. Brunelli. *Accad. Lincei, Atti*, 15. *pp.* 43–46, *Jan.* 3, 1932.—A solution was obtained by Got [see Abstract 684 (1932)] for the critical velocities of rotation of shafts of appreciable mass, when a load is applied at the middle point. Here a more simple case is first considered and two singular solutions are obtained; the method is then extended to a more general case. H. M. B.

1828. Elastic Extension of Wires. L. C. Tyte. *Phil. Mag.* 13. *pp.* 49–69, *Jan.*, 1932.—A differential method previously described [see Abstract 1443 (1931)] is employed to investigate deviations from Hooke's law for steel, iron, nickel, brass, copper, aluminium, zinc, tin and lead, all in the form of wires. These materials all deviate from Hooke's law over the whole experimental range by amounts which differ greatly in different cases. For annealed specimens the deviation increases with increase of crystal size. J. P. A.

1829. Elasticity and Strength of Quartz Fibres. O. Reinkober. *Phys. Zeits.* 33. *pp.* 32–38, *Jan.* 1, 1932.—Continuing an investigation upon the strength of quartz fibres [see Abstract 2150 (1931)], Young's modulus E, rigidity F and flexural strength K are found for a large number of quartz fibres varying in diameter from 1 to 100 μ. Down to thicknesses of 15 μ average values of E and F are related to the diameter thus: $E = 36{,}000/d + 4500$ and $F = 17{,}000/d + 2650$, where E and F are in kg./mm.^{2} and d is in μ. Below this thickness values calculated from the formulæ are too great. Similar results apply to K, but experiments were confined to fibres of diameter 50–100 μ. Poisson's ratio, calculated from E and F, is found to be negative, probably indicating inhomogeneity. In explanation a thin surface layer of high strength and elasticity is postulated as being more consonant with the results than the hypothesis of the orientation of ultimate microcrystals or grains. J. P. A.

1830. Plasticity and Hardening. O. Manfred. *Zeits. f. phys. Chem.* 15. *Abt.B.* 4–5. *pp.* 383–387, *Jan.*, 1932.—Evidence is presented to show that plastic distortion of a material is always followed by increase of hardness, whether the material is polycrystalline like a metal, or a plastic colloid like rubber. This parallel relation, which seems to be independent of the ultimate structure of the material, may be regarded as a new general principle. J. P. A.

1831. Plasticity and Rigidity in Notched Material. W. Kuntze. *Zeits. f. Physik*, 74. 1–2. *pp.* 45–65, *Jan.* 22, 1932.—A cylindrical steel bar was taken with a triangular groove cut round it. Investigations were carried out in respect to plastic stretching, to the limits of stretching, to the rigidity and to the breaking stretch, with varying depths of grooving; the causes of the shrinkage in the elastic limits, and the static brittleness: mechanical dissimilarities in respect of rigidity and of stretching brought about by notches. A. D.

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1832. Equations of Motion of Three Bodies of Variable Mass. I. I. Placinteanu. *Accad. Lincei, Atti,* 15. *pp.* 52–55, *Jan.* 3, 1932. *In French.*—The equations of motion are found for three bodies whose masses vary with time and which attract each other according to the inverse square law. G. C. McV.

1833. Structure of Sulphur-Iodine Compounds. Part I. Sulphur Compounds of the Tri-Iodides. E. Hertel. *Zeits. f. phys. Chem.* 15. *Abt.B.* 1. *pp.* 51–57, *Dec.*, 1931.—The compound $CHI_3 . 3S_8$ is trigonal, with one molecule in the unit cell. The S_8 molecules are not linear. $AsI_3 . 3S_8$ seems to be analogous. CHI_3 and AsI_3 are not isomorphous: $CHI_3 . 3S_8$ and $AsI_3 . 3S_8$ form mixed crystals in all proportions. F. I. G. R.

1834. Crystal Structure of an Organic Molecular Compound of the Type AB_2. E. Hertel and K. Schneider. *Zeits. f. phys. Chem.* 15. *Abt.B.* 1. *pp.* 79–83, *Dec.*, 1931.—The compound of stilbene with 2 molecules of trinitrobenzene forms triclinic crystals: $\alpha = 102° 16'$, $\beta = 85° 30'$ and $\gamma = 87° 35'$. The unit cell contains 2 molecules of the compound and has the dimensions: $a = 12 \cdot 7$, $b = 15 \cdot 4$ and $c = 7 \cdot 7$ Å. The configuration of the molecule is discussed. T. H. P.

1835. Crystal Structure of Copper Electrodeposited in the Presence of Gelatin. H. Kersten. *J. Phys. Chem.* 35. *pp.* 3644–3646, *Dec.*, 1931.—Copper, plated from an acid bath containing gelatin, is more brittle than without the gelatin. It has been suggested that the crystal structure differs in the two cases, but the author shows that if this is so, the difference in the length of the unit lattice must be less than $0 \cdot 01$ Å. F. I. G. R.

1836. Crystal Structure of the Tetra-Halides of the Lighter Elements. Part II. O. Hassel and H. Kringstad. *Zeits. f. phys. Chem.* 15. *Abt.B.* 4–5. *pp.* 274–280, *Jan.* 1, 1932.—The previous paper [see Abstract 3319 (1931)] dealt with the crystal structure of the tetrahalides of quadrivalent elements and the conclusions reached then have been mostly confirmed since, *e.g.*, the crystal structure of CI_4 is of a different type from that of SiI_4. In the present paper the X-ray investigation is described of the structures of $TiBr_4$ and TiI_4. In both cases a cubical structure is indicated of the type of SnI_4. The lattice constants amount to $11 \cdot 25$ and $12 \cdot 00$ Å. respectively. The atomic distances in the respective tetrahalides are discussed. H. H. Ho.

1837. Crystal Structure of Anhydrous Sodium Sulphate, Na_2SO_4. W. H. Zachariasen and G. E. Ziegler. *Zeits. f. Krist.* 81. 1–2. *pp.* 92–101, *Jan.*, 1932. *In English.*—The oscillation method was employed, and the intensities of reflection were carefully measured. The unit cell contains eight molecules, and $a = 5 \cdot 85$ Å., $b = 12 \cdot 29$ Å., $c = 9 \cdot 75$ Å., space group $Fddd(V_h^{24})$. Projections are given showing the positions of the atoms in the structure for the *c* face and for the *a* face. The values of the four parameters of the structure are determined entirely on the basis of the observed intensities, which gives a unique solution. Each sulphur atom is surrounded by 4 oxygen atoms, forming an almost perfect regular tetrahedron. Six oxygen atoms form a highly deformed octahedron round each sodium. Two of the tetrahedral edges of the SO_4 group are shared each with two NaO_6 polyhedra. All kations are separated by large distances. H. N. A.

1838. Lattice Dimensions of Spinels. G. L. Clark, A. Ally and A. E. Badger. *Am. J. Sci.* 22. *pp.* 539–546, *Dec.*, 1931.—Tables, derived from X-ray powder determinations, are given for the lattice constants of the following spinels—aluminates, chromites, ferrites of Mg, Zn, Fe and Mn (general formula $R''R_2'''O_4$). The cell dimensions, for a given R″, increase in the order aluminates, chromites, ferrites. They also increase in the order Zn, Mg, Fe, Mn with the single exception of zinc ferrite, which incidentally is paramagnetic whereas the others are ferromagnetic. Eight spinel molecules are always associated in the unit cell. F. I. G. R.

1839. X-Ray Examination of β-Methylxyloside. E. G. Cox. *Chem. Soc., J. pp.* 138–142, *Jan.*, 1932.—*β-d*-methylxyloside forms monoclinic sphenoidal crystals, $a:b:c = 1\cdot040:1:1\cdot022$, $\beta = 113° 25'$; the mean refractive index is approximately 1·51. X-ray examination by the rotating crystal method gives $a = 7\cdot82$, $b = 6\cdot89$, $c = 7\cdot74$ Å., $\beta = 113° 10'$. The poor agreement of the axial ratios found by the X-ray method and by goniometric measurement is probably because some of the faces observed are vicinal faces of high indices. On the basis of 2 molecules to the unit cell, the density is calculated to be 1·412, the experimental value being 1·40. The space-group is C_2^2. An interesting relationship between the cell-dimensions of α-xylose [see Abstract 691 (1932)] and those of this xyloside is indicated. T. H. P.

1840. X-Ray Examination of the Oxides of Lead. J. A. Darbyshire. *Chem. Soc., J. pp.* 211–219, *Jan.*, 1932.—Characteristic samples of the pure oxides of lead have been examined by the Debye-Scherrer X-ray powder method of analysis. The lattice constants and parameters are evaluated and a table is given, with references to all former work on the structure of these substances. Attempts to prepare lead oxide are described, but no definite compound was obtained. Lead sesquioxide was prepared by two different methods, but was found to be amorphous in both cases. Orange lead, apparently a modification of red lead, was found to have a structure identical with that of ordinary red lead. Commercial monoxides are generally mixtures of the red and the yellow variety. Commercial red lead is usually contaminated with yellow lead monoxide, rarely with red monoxide. The changes which take place when lead sesquioxide and lead dioxide are heated have been determined by X-ray photographs. The sesquioxide is converted into yellow monoxide when heated in air to 400°. The dioxide decomposes into a mixture of red monoxide and yellow monoxide when heated to 300° in a vacuum. Lead dioxide containing 15 % of the red variety of the monoxide, when heated in the same manner, yielded a considerable amount of red lead. H. H. Ho.

1841. X-Ray Examination of d-Mannitol and d-Mannose. G. W. McCrea. *Roy. Soc. Edinburgh, Proc.* 51. *pp.* 190–197, 1931–1932.—*d*-Mannitol crystallises in the orthorhombic bisphenoidal class, the space group being Q_4; the unit cell contains four molecules and has the dimensions $a = 8\cdot66$, $b = 16\cdot58$, $c = 5\cdot501$ Å., and the calculated density is 1·522 gm. per c.c. The greatest length of the molecule corresponds with the *a* axis and the molecules have a long chain configuration. *d*-Mannose forms orthorhombic bisphenoidal crystals of the space group Q_4. The unit cell, with four molecules, has $a = 5\cdot53$, $b = 17\cdot66$ and $c = 7\cdot59$ Å.; calculated density 1·602 gm. per c.c. A manno-pyranose ring structure is probable in the *d*-mannose molecule, which has its greatest length along the *c* axis. T. H. P.

1842. X-Ray Determination of Elastic Tensions in Bent Crystals. S. Konobejewski and I. Mirer. *Zeits. f. Krist.* 81. 1–2. *pp.* 69–91, *Jan.*, 1932.—Rock-salt and gypsum crystals were bent plastically and afterwards bent straight again; they were also heated to the recrystallisation temperature. Laue X-ray diagrams were taken at different stages, and a study of these leads to the conclusions that the space lattice is bent with small slips of the slip lamellæ, and that when the bent crystal is heated to recrystallisation a monocrystal is broken up into crystal fragments which are orientated like the deformed lattice, and a microcrystalline aggregate is formed. H. N. A.

1843. Alternating Torsion Experiments with Zinc Crystals. W. Fahrenhorst and E. Schmid. *Zeits. f. Metallkunde*, 23. *pp.* 323–328, *Dec.*, 1931.—It is shown by a study of the plastic behaviour of single zinc crystals when submitted to alternating torsion experiments, that an initial crystal solidification is followed by a relaxation, since period determinations have shown the tenacity to pass through a maximum value. Illustrative diagrams of the changed crystalline structure are included. H. H. Ho.

1844. Lattice-Distortion of Cold-Drawn Constantan Wire. W. A. Wood. *Phys. Soc., Proc.* 44. *pp.* 67–74; *Disc.*, 74–75, *Jan.* 1, 1932. —The space-lattice of constantan is found to undergo large distortion as a result of cold-working. A method is described for determining the variation in distortion quantitatively as constantan wire is cold-drawn, and the variation across the section of the wire during the drawing. It is found that (*a*) the distortion on drawing increases quickly to a steady maximum, which is maintained despite further drawing; (*b*) orientation does not begin until the maximum distortion appears; (*c*) just below the surface in the less drawn wires is a region of diminished distortion, but as the wire is further drawn the degree of distortion evens out across the section (this is explained in terms of the action of the die on the surface); (*d*) the temperature-coefficient of electrical resistance exhibits changes in drawing similar to the variation in distortion, and the two properties are practically proportional. AUTHOR.

1845. Physical Properties of Single-Crystal Magnesium. P. W. Bridgman. *Am. Acad., Proc.* 67. 2. *pp.* 29–41, *Jan.*, 1932.—The five elastic constants, the thermal expansion and the thermoelectric properties of single-crystal magnesium have been measured. F. J. W.

1846. Single-Crystal Spectrometric Data on Urea. R. W. G. Wyckoff. *Zeits. f. Krist.* 81. 1–2. *pp.* 102–109, *Jan.*, 1932. *In English.*—Single-crystal spectrometric measurements with molybdenum, copper, nickel and iron radiations have been made. The intensities corrected for extinction, using powder spectrometric data, have supplied coefficients for a Fourier analysis of scattering matter projected on the *c* face. The nitrogen parameter is $u = 0\cdot145 \pm$ ca. $0\cdot005$. There is no indication of H-atoms outside NH_2 groups. The F-values of NH_2 agree with those of NH_4 in NH_4Cl. The experimental C + O curve is practically identical with the sum of the carbon curve from graphite and the oxygen curve from metallic oxides. H. N. A.

1847. Crystals Produced by Solidification of a Fused Substance Containing Dyes in Solution. P. Gaubert. *Comptes Rendus,* 194. *pp.* 109–111, *Jan.* 4, 1932.—1 to 20 % of different dyes were added to various easily fusible colourless organic substances, *e.g.*, vanillin, erythrite, codeine, etc., which were capable of considerable undercooling. If crystallisation occurs near the ordinary melting point the crystals are colourless, but if at a lower temperature they are coloured, homogeneous, polychroic and fluorescent in ultra-violet light. Where a substance, *e.g.*, vanillin, is obtainable in different modifications these are differently affected as regards tint, rate of change from one to another and relative amount of the different forms. [See Abstract 229 (1922).] C. A. S.

1848. Crystallisation of Paraffin Wax. E. Katz. *Inst. Petroleum Technologists, J.* 18. *pp.* 37–52, *Jan.*, 1932.—The existence in paraffin wax of groups of components possessing a characteristic crystalline form was not observed, but development of either form depends entirely on the concentration of the solution and temperature at which crystallisation begins. Crystallisation in plates ceases and that in needles begins at, and continues above the concentration of change c. The saturation temperature (*i.e.*, the temperature at which the cooling solution becomes cloudy from formation of crystals) for this concentration is termed the temperature of change t. With a paraffin of melting point 51·6° dissolved in lubricating oils of viscosities 6·4 and 22° E. at 50°, c and t are respectively 49·5 %, 46·3°; and 52 %, 46·7°; in kerosene 67·5 %, 46·4°; benzole 84 %, 46°; carbon disulphide 83 %, 46·6°; carbon tetrachloride 74·5 %, 46·4°; nitrobenzene 8·5 %, 49·5°; and in *m*-cresol 4 %, 55·5°. To obtain the needle form, therefore, a solution having a saturation temperature higher than t must be prepared; solutions with lower saturation temperature yield the plate form. c and t vary according to the melting point of the paraffin. C. A. S.

1849. Reactions of Graphite as a Disperse Laminar System. U. Hofmann and A. Frenzel. *Kolloid Zeits.* 58. *pp.* 8–14, *Jan.*, 1932. —The crystal lattice of graphite has the structure of a disperse laminar system, built up of plane layers. Graphite is thus capable of peculiar reactions in which these layers persist, only the linking between the layers being dissolved or altered. The products of such reactions also possess a disperse-laminar structure, often to a more marked degree than graphite itself. To these reactions belongs the formation of alkali-graphite compounds in which an alkali metal layer is inserted between two of the carbon layers, probably with production of alloy. This property of graphite is probably related to its lubricating action. The layers also persist on formation of graphitic acid, and the disperse-laminar structure of the graphitic acid crystal is shown distinctly in the peculiar swelling phenomenon of the acid and in its re-conversion into graphite. The transformation of graphite into a brown-translucent form with blue lustre when treated with concentrated sulphuric acid containing an oxidising agent, appears to be a reaction of similar type. T. H. P.

1850. Behaviour of Liquid Crystals in the Electric Field. K. Herrmann, A. H. Krummacher and K. May. *Zeits. f. Physik,* 73. 7–8. *pp.* 419–436, *Dec.* 30, 1931.—The following liquid crystals were investigated in the electrostatic field by X-ray and optical means: *p*-azoxyanisole, dianisaldazine, phenetoleazoxybenzoic acid allyl ester [see also Abstract 2956 (1931)] and *p*-ethoxybenzalamine–cinnamic acid methyl ester; the directions being determined in which the long axes of the molecules were orientated. Initial conflicting data entailed further investigation, whereby a definite flow was established which exerted a strong directing influence upon the molecules. This new result explains a number of previous difficulties in X-ray methods. Zocher's opinion is supported, *viz.*, that the liquid crystals with similar molecular ends endeavour to set themselves in the nematic phase with their long axes perpendicular to the lines of force, whereas the molecules with dissimilar ends tend to have their long axes parallel. H. H. Ho.

1851. Vibrations of Pentatomic Tetrahedral Molecules. H. C. Urey and C. A. Bradley, Jr. *Phys. Rev.* 38. *pp.* 1969–1978, *Dec.* 1, 1931.—The frequencies of vibration of symmetrical tetrahedral molecules with a fifth atom at the centre of gravity have been calculated, assuming harmonic restoring forces along the valence bonds and perpendicular to them. This does not give satisfactory agreement, but does so when there is included a repulsion between the corner atoms, in the cases of CCl_4, $SiCl_4$, $SnCl_4$, CBr_4 and $SnBr_4$, but not in the case of $TiCl_4$. The force added is proportional to the inverse 6th to 10th power of the distance apart. In the cases of $SO_4^{=}$ and ClO_4^{-} extra terms are necessary. A. C. M.

1852. Normals or Standards for Atomic Weights. R. Mecke. *Phys. Zeits.* 33. *pp.* 49–50, *Jan.* 1, 1932.—The author has found, by means of accurate intensity measurements on the atmospheric oxygen bands, that the ratio between the abundance frequencies of the oxygen isotopes is $O^{16}:O^{18}:O^{17} = 630:1:0{\cdot}2$. He points out, however, that this is an average value for the whole atmosphere, and that the actual proportions of O^{18} and O^{17} must be greater in the lower portions of the atmosphere than higher up. This leads him to consider what is the best standard from which atomic weights should be defined. He rejects the suggestion that the atomic weight of hydrogen should be taken as unity, suggests the possibility of making the atomic weight of helium 4·000, which would have advantages since helium has no isotopes; thinks that it is too early to give each element its chemical structural formula, number of nuclear protons, α-particles, nuclear electrons, external electrons, together with the mass defect due to conversion of mass into heat in the nuclear reaction. Concludes that the atomic weight of the isotope O^{16} should be taken as 16·0000. H. N. A.

1853. Present Position of the Atomic Theory. R. Swinne. *E.T.Z.* 53. *pp.* 73–75, *Jan.* 28, 1932.—Important developments since 1900 are briefly sketched, particularly the topics of material waves, quantum and wave mechanics, and of the distribution of charge in atoms. Pauling's diagrams giving the distribution of electricity as a function of nuclear distance for various states of the unperturbed H-atom are reproduced. N. D.

1854. Nuclear Structure. A. Carrelli. *Phys. Zeits.* 33. *pp.* 73–76, *Jan.* 15, 1932.—The author considers in detail how the mass defect of the nucleus is affected by its structure, and by the number of free nuclear electrons. Gamow's formula for the mass defect applies to the $4N_{\alpha}$ type of nucleus with no free nuclear electrons. He endeavours to find modifications of Gamow's formula which will make it fit in the case of free nuclear electrons. H. N. A.

1855. Energetic Considerations with Respect to Inorganic Halides. W. Hückel. *Zeits. f. phys. Chem.* 15. *Abt.B.* 2–3. *pp.* 242–247, *Dec.*, 1931.—It is shown that the method given by Bergmann and Engel [see Abstract 4269 (1931)] for the calculation of atomic radii is invalid since it contains fundamental errors. H. H. Ho.

1856. Formula and Constitution of a Hydrocarbon Having a Violet Fluorescence, $C_{42}H_{26}$. C. Dufraisse and L. Enderlin. *Comptes Rendus,* 194. *pp.* 183–185, *Jan.* 11, 1932.—A substance $C_{42}H_{26}$ occurs in the preparation of rubrene, as a by-product, which is uncoloured but has an intense violet fluorescence itself and in solutions. The substance may be prepared either by dehydrogenating rubrene ($C_{42}H_{28}$) by oxidation: $C_{42}H_{28} \xrightarrow{+O} C_{42}H_{28}O \xrightarrow{-H_2O} C_{42}H_{26}$, or by dehydrating dihydroxydihydrorubrene ($C_{42}H_{28}(OH)_2$). The structural formula is given. J. E.

1857. Cohesive Forces and Molecular Sphere of Activity in Metals. C. Benedicks. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 22*A*. 24. [13. *pp*], 1932. *In English.*—A comparison is made of r, the molecular sphere of activity, which is taken as 2H/K, where H/2 is the surface tension and K the internal pressure, and the apparent atomic radius ρ as defined by Bragg. It is found that r is approximately equal to ρ^6, *i.e.*, the radius of the molecular sphere is approximately proportional to the second power of the atomic volume. For active substances, *e.g.*, Na and K, both r and ρ are found to be large. It is concluded that on decreasing the atomic distance the cohesive force must finally be constant (*i.e.*, independent of distance) and not increase rapidly as is frequently assumed. H. M. B.

1858. Beryllium Molecule. W. H. Furry and J. H. Bartlett, Jr. *Phys. Rev.* 39. *pp.* 210–225, *Jan.* 15, 1932.—The interaction of a normal Be atom with one which has an electronic configuration $2s2p$ has been studied by means of the Heitler-London method. Of the eight possible molecular states, two are calculated to be stable, namely $^1\Sigma A^N$ and $^1\Pi A^N$, and the $^1\Sigma$ state is the lower of the two. An attempt to obtain agreement with experiment in the case where a normal Li atom interacts with one in the $2p^2P$ state has not been successful, at least for the resulting Π states. AUTHORS.

1859. Behaviour of Atoms in a Rotating Magnetic Field. P. Güttinger. *Zeits. f. Physik,* 73. 3–4. *pp.* 169–184, *Dec.* 2, 1931.—The behaviour of a beam of free atoms in a rotating magnetic field is investigated mathematically. Probabilities of transition between stationary states in a steady field are calculated. Explicit expressions for the irreducible matrices representing the spin groups are given. For an experimental test of the theory see the following Abstract. N. D.

1860. Experimental Test of Quantisation in Direction. T. E. Phipps and O. Stern. *Zeits. f. Physik,* 73. 3–4. *pp.* 185–191, *Dec.* 2, 1931.—The behaviour is discussed of a beam of atomic rays, whose atomic axes are all parallel to a magnetic field when passed through a second non-uniform magnetic field. According to Darwin [see Abstract 835 (1928)] part of the atoms should set parallel and part antiparallel to the field. Stern has suggested that the tacit assumption that the alteration of the direction of the magnetic field takes place in a strictly non-adiabatic way, is not fulfilled in the usual experimental conditions. An arrangement is described in which, by making the second field weak and then sending the atoms into a third strong and non-uniform field, the number of atoms antiparallel to the second field can be measured. At the same time the condition of non-adiabaticity is fulfilled. Preliminary results are given. In only one case are antiparallel atoms found, and it is not certain that their behaviour is due to the mechanism suggested. [See preceding Abstract.] N. D.

1861. Influence of a Cloud of Electrons on the Structure of de Broglie Waves. S. Szczeniowski and L. Infeld. *Acad. Polonaise Sci. et Lettres, Bull. No. 6A. pp.* 482–488, *June,* 1931. *In English.*—The solution of Schrödinger's wave equation is found for an electron when in the presence of a cloud of electrons which produce a (negative) volume-charge of electricity. The theory is applied to explain the width of the diffracted electron beam in the Davisson and Germer type of diffraction experiment. The calculated widths, however, are much smaller than those observed. G. C. McV.

1862. Monochromatic de Broglie Waves of Molecular Beams. I. Estermann, R. Frisch and O. Stern. *Zeits. f. Physik,* 73. 5–6. *pp.* 348–365, *Dec.* 10, 1931.—The equation of de Broglie, $\lambda = h/mv$, for the wave-length corresponding to a particle with mass m, moving with velocity v, makes it possible to compare the results obtained by diffracting a beam of He atoms from the surface of a LiF crystal, which acts on it like a crossed grating, and those obtained by sending the molecular beam through a toothed-wheel system, which only allows atoms within a certain velocity range to pass. In the first case atoms (waves) diffracted in a certain direction can be separated from the others, the beam being rendered "monochromatic." The actual result is the same as that obtained by the rough mechanical method. H. N. A.

1863. Paradox of Klein. F. Sauter. *Zeits. f. Physik,* 73. 7–8. *pp.* 547–552, *Dec.* 30, 1931.—The author points out that his calculation of the probability of penetration, by an electron with negative energy, of a potential barrier which increases linearly, had been anticipated by Szczeniowski. He performs the calculation again for a different law of potential increase. **Szczeniowski,** *ibid.,* pp. 553–559, shows that his form of the result agrees with that of the author. G. C. McV.

1864. Interaction of Radiation and the Electron. R. D. Kleeman. *Phil. Mag.* 13. *pp.* 69–76, *Jan.,* 1932.—In order to explain the connection between the electron and radiation and yet to retain the electromagnetic theory of radiation in its orthodox form, seven assumptions concerning the properties of the electron and proton are made. Evidence supporting these assumptions is adduced. They are then used to explain the laws governing three important phenomena, which are difficult to explain on the older theory, *viz.,* Einstein's law of photoelectricity, the Compton effect, and the reflection of electrons from crystals. N. D.

1865. Classical Energy and the Interpretation of Schrödinger's ψ-Function. A. Press. *Phil. Mag.* 13. *pp.* 112–115, *Jan.,* 1932.—The classical equation of motion of an asymmetrical diaphragm is written down, the particular diaphragm being of the centrally-weighted type due to L. V. King. A radiation pressure term $R\,dr/dt$ is included. The equation is then transformed to the Schrödinger type, whose ψ-function can be interpreted. It consists of a component which relates to a "steady state," and a component representing the energy radiated between displacements 0 and *x*, and characterising a certain energy level. The loaded diaphragm considered is analogous, in a certain sense, to Planck's oscillator. N. D.

1866. Wave Mechanics and General Quantum Mechanics. G. Juvet. *R.G.E.* 31. *pp.* 77–86, *Jan.* 16, *and pp.* 112–121, *Jan.* 23, 1932.—A *résumé* of the methods and problems of the new mechanics of the atom. The relations of the wave-mechanics of Schrödinger and de Broglie to the general quantum mechanics of Dirac and Weyl are discussed. The equivalence of the two methods is brought out. There follows an account of the theory of the H atom and of Dirac's relativistic theory of the so-called " spinning " electron. G. C. McV.

1867. Treatment of the Relativistic Problem of Many Bodies in Accordance with Heisenberg's Correspondence Principle. L. Rosenfeld. *Zeits. f. Physik,* 73. 3–4. *pp.* 253–259, *Dec.* 2, 1931.—The problem of the mutual action of particles is treated mathematically in accordance with Heisenberg's correspondence principle. The relativistic treatment of the impact problem by Møller is extended, and the results are in accord with those deduced by Breit in another manner. J. S. G. T.

1868. Viscosity of the Phase Space. K. C. Kar. *Indian Phys. Math. J.* 3. *pp.* 1–2. *Jan.*, 1932.—Wave equations are derived for the *p*- and *q*-spaces of the author's wave-statistical theory, involving the coefficients of the respective spaces. J. S. G. T.

1869. Wave Statistics. K. K. Mukherjee. *Indian Phys. Math. J.* 3. *pp.* 3–8, *Jan.*, 1932.—The theory of wave statistics giving a statistical interpretation of Schrödinger's wave equation, developed in previous papers [see Abstract 359 (1931)] is extended to derive expressions for the velocity of waves in the momenta space and for the current. J. S. G. T.

1870. Dirac Equations in General Relativity. Parts I and II. J. A. Schouten. *J. Math. Phys., Mass. Inst. of Technology,* 10. *pp.* 239–283, *Dec.*, 1931.—Part I.—Symbols and equations of Ricci-calculus are discussed; the theory of spin-quantities in Minkowskian space-time and in Riemannian space-time is developed and covariant differentiation of the latter discussed. It is shown that by the influence of a gravitational field, the components of the potential vector change from ordinary to Dirac numbers. The simplest covariant Dirac equation of the second order that can be linearised is deduced, and the variational equations are discussed which are obtained by starting with a scalar density differing from that used by Weyl only by a term due to the non-symmetrical character of the displacement in space-time. Part II.—The Dirac equations are shown to enter automatically into the theory when a five-dimensional manifold is used in place of a four-dimensional Riemannian manifold. J. S. G. T.

1871. Riemannian Manifolds and Non-Euclidean Space Forms. Part VII. P. Koebe. *Preuss. Akad. Wiss. Berlin, Ber.* 24. *pp.* 506–534, 1931.—In continuation of previous work [see Abstract 1813 (1931)], the author discusses absolute measurement in Riemannian manifolds possessing singularities. J. S. G. T.

V. 19

1872. Electromagnetism and Riemannian Geometry. C. Lanczos. *Zeits. f. Physik*, 73. 3–4. *pp.* 147–168, *Dec.* 2, 1931. *Phys. Rev.* 39. *pp.* 716–736, *Feb.* 15, 1932.—A unified field theory of electromagnetism and gravitation is set up under the assumptions that the geometry of the field is Riemannian and that a conservation law for the matter-tensor holds in the field. Under these circumstances, any set of field-equations obtained from the variation of action-integrals whose Hamiltonian functions are formed solely by combinations of the contracted Riemann tensor and the fundamental tensor of the metric, can be integrated and this integration involves the introduction of an arbitrary four-vector. The author then shows that this four-vector can be identified with the vector-potential of the electromagnetic force in the field. This is possible if the Hamiltonian function is the scalar which is quadratic in the components of the contracted Riemann tensor. From the field-equations it then follows that the scalar curvature of the field is constant and that the continuity equation for the vector potential holds. But the identification cannot be carried out unless a special form of action-integral for the interaction between a charged particle and the field outside it is assumed.
G. C. McV.

1873. Possibilities in Relativistic Thermodynamics for Irreversible Processes Without Exhaustion of Free Energy. R. C. Tolman. *Phys. Rev.* 39. *pp.* 320–336, *Jan.* 15, 1932.—Previous applications of relativistic thermodynamics [see Abstract 3054 (1930)] have been either to systems in static thermodynamic equilibrium or to non-static systems in which reversible processes are taking place. The present article deals with non-static systems in which irreversible processes take place. It is shown that the failure of the principle of energy conservation to hold in relativistic mechanics in its older simple form removes a classical limitation on the irreversible increases in entropy which can take place in an isolated system. The removal of this limitation provides possibilities in relativisitic thermodynamics for irreversible processes to take place in an isolated system without ever reaching an unsurpassable state of maximum entropy and minimum free energy where further change would be impossible. Such possibilities are found to be illustrated by non-static models of the universe which could undergo a continued series of irreversible expansions and contractions without ever arriving at a state of rest. Special attention is given to a non-static model of the universe in which the irreversible annihilation of matter would take place in the later stages of expansion and the irreversible formation of matter out of radiation in the later stages of contraction. Finally, remarks are made concerning the bearing of the findings on the interpretation of phenomena in the actual universe.
AUTHOR.

1874. Model of the Universe. J. Loiseau. *R.G.E.* 31. *pp.* 35–42, *Jan.* 9, 1932.—If the universe is looked upon as a three-dimensional fluid hypersphere with surface-tension, the movements of the hypersurface of this hypersphere can be identified with light-waves and de Broglie waves, whilst the inertial forces due to these movements constitute electromagnetic fields.
G. C. McV.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

1875. Mean Temperatures for Latitude Belts from Solar Radiation. R. Spitaler. *Gerlands Beitr. z. Geophys.* 35. 1. *pp.* 87–101, 1932.—Based on the results obtained by Spitaler, Batchelder and Hopfner, values of mean temperature are calculated for each 5° belt of latitude for each hemisphere for the year, Jan. and July. Another table gives the calculated results based on the author's equation for radiation, for the year, Jan. and July, and the summer and winter half-years for each belt of 5° of latitude. Next the mean yearly temperature (t_ϕ) for each 5° belt is expressed in terms of the yearly radiation (S_0) for the belt and the extent of land (n) and four constants in the form $t_\phi = (A + BS_0)(1 - n) + (C + DS_0)n$. Mean values for A, B, C and D are found for the range 65° N.–65° S. The mean deviation over this range is $\pm 0{\cdot}56$. For the two hemispheres, water (100° E.–80° W.) and land, summer and winter temperatures are obtained and tabulated for 5° belts using S_0 and S, the radiation from Hopfner's formulæ for the yearly mean, and for Jan. and July respectively. Lastly the observed and calculated values for the two hemispheres are compared for 5° latitude belts. R. S. R.

1876. Distribution of Ozone in the Atmosphere. D. Chalonge. *J. de Physique et le Radium*, 3. *pp.* 21–42, *Jan.*, 1932.—All that has been validly concluded from earlier observations is that the ozone absorption occurs as if it were due to a thin layer at a height of 50 km. From observations made on radiation from a blue sky it is concluded that there should be quite appreciable amounts of ozone at 20 km. and less, and extending up to 80 km., the concentration increasing with altitude. A. C. M.

1877. Correlation Between Frost and the Preceding Meteorological Conditions. B. Ali and S. N. Naqvi. *Indian J. of Agricultural Science*, 1. *pp.* 671–694, *Dec.*, 1931.—Observations at 16 hours (local time) for Lahore for the period 1915–29 have been analysed statistically and equations developed between the minimum temperature of the night and the dew-point, wet-bulb and dry-bulb temperatures at 16 hours of the preceding afternoon. The physical significance of these equations is discussed. The observed and calculated values of minimum temperature agree to ± 2° C. in 93 % of cases. The causes producing discrepancies are explained. Most of these can be foreseen by a forecaster having the facilities of an Indian synoptic chart as they involve the entry of a new air supply after 16 hours. The most favourable pressure distributions for the occurrence of frost are discussed. To safeguard agricultural operations against frost regular afternoon observations of air temperature and humidity are necessary. R. S. R.

1878. Seasonal Weather Forecasting. C. W. B. Normand. *Roy. Meteorolog. Soc., J.* 58. *pp.* 3–10, *Jan.*, 1932.—The author considers that the weather during the preceding few seasons over a large area, indeed over the world, seems to provide a better basis for prediction than solar cycles or terrestrial periodicities apart from the annual cycle. The physical causes of the connection between one season's weather at one side of the globe and the weather at a later season at the other side are not understood. The author then reviews the possible use of the solar cycle and changes in solar radiation, periodicities especially those of 35,

19 and 11 years, the criteria of reality for periodicity, hidden periodicities which produce sudden changes of phase, forecasting from seasonal maps and from individual factors. Correlation methods are examined, the selection of factors, and Walker's and Fisher's significance tests. Finally the standard of accuracy to be attained in the forecasts is discussed.
R. S. R.

1879. Morning and Evening Colorations of the Clouds. P. Barreca. *Accad. Lincei, Atti*, 14. *pp*. 427–432, *Nov*. 15, 1931.—A method is described by which the particular durations of the colours in the clouds at evening and at dawn can be reduced to the equator and to the equinox. This depends on the author's views regarding the coloration of all terrestrial objects at morning and evening as due to invisible coloured rings surrounding the globe and cut by the clouds or other objects in the diurnal rotation, the rings remaining unmoved with respect to the sun. J. J. S.

1880. Forms of Stratified Clouds. A. C. Phillips and G. T. Walker. *Roy. Meteorolog. Soc., J*. 58. *pp*. 23–28; *Disc*., 28–30, *Jan*., 1932. —In continuation of experimental work on vertically unstable liquids by E. H. Weber, Bénard, Idrac and Mal an examination was made of the patterns set up in a heated liquid moving along a rectangular trough. As this did not produce vortices with their axes at right angles to the flow, recourse was had to unstable air flowing along a small wind channel, the motion being indicated by fumes of $TiCl_4$. By suitable increases of velocity from zero, the patterns produced were polygons and transverse, crossed and longitudinal vortices, the resemblance to clouds being more obvious than when liquids were used. In the *Discussion* **G. T. Walker** emphasised that it must be remembered that the shear changes sign and that the motion inside the cell was downward, not upward as with liquids. Downward motion in clouds in the sky is at times conspicuous and reference is made to some cases, but upward motion is far more frequent. **D. Brunt** referred to the difficulty of obtaining actual measurements of the depths of layers of instability and of lapse rates in clouds. **C. K. M. Douglas** stated that shearing affected not only the structure of clouds but helped to produce instability, and he referred also to horizontal and vertical temperature differences in broken cloud layers. R. S. R.

1881. New Wind Measurer. J. W. Sandström. *Gerlands Beitr. z. Geophys*. 35. 1. *pp*. 82–86, 1932.—Particulars are given of a new type of cup anemometer which, in addition to recording wind speed with the help of a chronograph drum, also records wind direction to 16 points. An electrical arrangement is employed for marking on the drum with one pointer, marks above the zero line being used for direction and below for speed. The number of contacts below the line in a given time gives the speed, while by a special construction the number of contacts above the line in this time gives the direction. The advantages claimed for the instrument are its simplicity and relatively small cost. R. S. R.

1882. Melting Point Within the Earth. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement*, 3. *pp*. 6–9, *Jan*., 1932.—It is found that the melting-point gradient everywhere exceeds the adiabatic, and that the shell therefore solidified from the bottom upwards. If the central core is mainly iron, pressure lowers its melting point. The core-material is not a degenerate gas, but a true fluid. The core consists of a liquid mass cooling from the top. W. A. R.

1883. Thickness of Continental Layers. A. W. Lee. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 3. *pp.* 13–21, *Jan.,* 1932.—A novel method is given to analyse the connection between time of origin of an earthquake, the depth of focus, apparent times of starting of the seismic waves, and the thicknesses of layers through which they travel. Practical applications of the method are worked out. W. A. R.

1884. Strength of the Earth's Crust. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement.* 3. *pp.* 30–41, *Jan.,* 1932.—The maximum stress difference below a surface elevation of the form $a \cos \kappa x$ is $0{\cdot}68\zeta\sigma a$, if there is no restriction on the vertical distribution of strength. σ is the density of the uppermost rocks. If the crust is of variable thickness resting on a denser material of no strength, the stress difference is nowhere greater than $\zeta\sigma a$. W. A. R.

1885. Isostasy. J. de G. Hunter. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 3. *pp.* 42–51, *Jan.,* 1932.—Examination of survey results shows that regions exist where the Hayford hypothesis closely resembles facts, but that regions also exist where the reverse is the case. With less than 2 % of the earth's surface gravitationally explored, it is useless to conjecture what proportion of the earth accords with the hypothesis. It is misleading to use the term " principle of isostasy " in the sense of Hayford compensation. Hayford compensation cannot be assumed to have actuality in any region unless measurement shows that it has. We can use the concept of Hayford compensation as an ideal standard, with reference to which gravity anomalies may be stated. Anomalies will thereby be very probably freed from the disturbing effects of mountain ranges, etc., at great and medium distances. W. A. R.

1886. Accumulation and Dissipation of the Energy of Secondary Undulations in a Bay. M. Nakano. *Phys. Math. Soc., Japan, Proc.* 14. *pp.* 44–56, *Jan.,* 1932.—The period of the secondary undulations in a bay have already been fully investigated, but it remains still to investigate the amplitudes, especially the rate of variation, or the rate of accumulation or dissipation of energy. In a bay with a large area in comparison with a narrow mouth, *viz.,* in a bag-shaped bay, the rate of accumulation or dissipation of energy of the secondary undulations may be expected to be small compared with the contrary case, *viz.,* in a funnel-shaped bay. The problem is now discussed of expressing the rate of variation of energy of the secondary undulations in a bay as a function of its size and form.
AUTHOR.

1887. Tidal Stresses and Earthquakes. D. M. Y. Sommerville. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 3. *pp.* 1–5, *Jan.,* 1932.—The effect of sun and moon tides is reconsidered with reference to earthquake occurrence. It is concluded that tides provide no ground for earthquake prediction. W. A. R.

1888. Earthquakes and Thunderstorms. T. Terada. *Tokyo Univ. Earthquake Research Inst., Bull.* 9. *pp.* 387–397, *Dec.,* 1931. *In English. Imp. Acad. Tokyo, Proc.* 7. *pp.* 341–343, *Nov.,* 1931. *In English.* —Curves showing, during the months July–September 1915–30, the numbers of earthquakes and thunderstorms in the Kwanto district are deemed to show some similarity, and the occurrences of rocket lightning (described in detail) to have been near those of more severe earthquakes. The possible mechanism of such a connection is discussed. C. A. S.

1889. Plastico-Elastic Deformation of a Semi-Infinite Solid Body by an Internal Force. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 9. *pp.* 398–406, *Dec.*, 1931. *In English.*—A spherical centre of pressure is assumed to exist at a given depth, the pressure being distributed symmetrically about the centre; the material in a sphere somewhat larger is completely plastic, and outside that elastic. The displacements and stresses at the surface are calculated two- and three-dimensionally, and are shown to depend largely on the position of the boundary between the plastic and elastic regions, while the vertical displacement at a point on the surface is inversely proportional to the cube of its distance from the centre of pressure. Applied to the results of relevelling after the 1929 Komogate eruption a focal depth of $\ngtr 3$ km. is deduced in fair agreement with seismographic deductions. C. A. S.

1890. Comparative Earthquake Motions Above Ground and in a Tunnel. N. Nasu. *Tokyô Univ. Earthquake Research Inst., Bull.* 9. *pp.* 454–472, *Dec.*, 1931. *In English.*—Seismographs, as nearly as possible identical, were placed, one in the Tanna tunnel, between Tokyo and Kobe, about 3 km. from the nearer entrance, the other on the surface 160 m. above the first. The soil is similar throughout. The corrections necessary to secure strictly comparable seismograms are discussed in detail. Such seismograms are given and discussed. In general movement is greater on the surface, especially for quick vibrations; thus if the period is $< 1''$ the ratio of amplitudes above to those below ground is $> 2 : 1$, but if $4''$ the amplitudes are about equal. C. A. S.

1891. Characteristics of Seismic Waves as Recorded by the Accelerometric Seismograph. M. Ishimoto. *Tokyo Univ. Earthquake Research Inst., Bull.* 9. *pp.* 473–484, *Dec.*, 1931. *In French.*—Further examples, with discussion, of records of moderate earthquakes near Tokyo obtained with the author's accelerometric seismograph [see Abstract 355 (1932)]. The instrument is specially suited for recording shocks of small period, *e.g.*, $0{\cdot}2''$. A sharp change in recorded amplitude marks the change from P to S waves. The primary waves carrying the disturbance direct from the focus, which give rise to the secondary waves on reaching the surface, are recorded as solitary waves, but are less apparent in a predominantly sedimentary region such as around Tokyo, than they would be in, *e.g.*, a granitic region. For observing such the new instrument should prove specially suitable. C. A. S.

1892. Deduction of Permanent Dislocation from the Seismogram. C. Tsuboi. *Imp. Acad. Tokyo, Proc.* 7. *pp.* 371–374, *Dec.*, 1931. *In English.*—The motion of a pendulum installed on a shaking table was recorded optically, giving a curve which was compared with the calculated displacements of the table that gave rise to the motion. It is suggested that conversely a record on a sufficiently large scale of the motion of a pendulum during an earthquake should make it possible to determine the amount of the displacement of its point of suspension. C. A. S.

1893. Portable Seismograph for Recording Artificial Earthquakes. J. H. Jones and D. T. Jones. *Journ. Sci. Instruments*, 9. *pp.* 8–16, *Jan.*, 1932.—A portable seismograph for recording artificial earthquakes is described. The motion of the pendulum is magnified by means of an arrangement of two small magnets and a soft iron element suspended on a phosphor-bronze strip which is attached to the pendulum.

The coupling of the magnifying system to the pendulum introduces a couple which opposes the restoring moment of the pendulum and lengthens the periodic time of the seismograph. Other important features of the instrument are the absence of friction from the magnification linkage and simple methods for the remote control of the " zero," the period and the sensitivity. An experimental investigation of the relation between the period and sensitivity is described. AUTHORS.

1894. Travel Time Curves at Small Distances, and Wave Velocities in Southern California. B. Gutenberg. *Gerlands Beitr. z. Geophys.* 35. 1. *pp.* 6–45, 1932. *In English.*—The foci of 21 earthquakes in S. California are accurately determined from observations at 10 stations. The velocity, 5·55 km./sec., of $\overline{P}$ holds for distances $> 200 < 450$ km., but is slightly less for shorter, greater for longer distances; that of P_n is 7·94 km./sec. Close behind P_n follows (figures in brackets denote velocities) P_x (7·60), with amplitude > that of P_n, and at greater distances sometimes perceptible as first wave. Between P_n and $\overline{P}$ also appear P_m (6·83), and P_y (6·05). P_m may be P^* in Europe, but it is doubtful if P_y has been recognised there. Three other longitudinal waves, *a* (7·10), *b* (6·56) and *c* (5·94) were recognised at distances > 200 km. The structure of California is similar to that of N. Germany save for the absence in the latter of the uppermost layer. $\overline{S}$ (3·23) may be overlapped by and confused with Q (Love waves); S_n (4·45), S_x (4·24), S_y (4·66), and S_m (3·39), and probably R (Rayleigh waves) (2·98), are often clearly recognisable; S_y seems to correspond with S^* in Europe, and S_m may be $\overline{S}$ there; 15 other waves with velocities from 5·36 to 3·05 were occasionally noted. The focal depth is probably 12 km., the corresponding thickness of the granitic layer being 14 km. [See Abstract 852 (1928).] C. A. S.

1895. Chronology of the Ice Ages. R. Spitaler. *Gerlands Beitr. z. Geophys.* 35. 1. *pp.* 102–112, 1932.—Reference is made to the radiation curve obtained by Milankovitch from summer radiation conditions over the earth and the calculated mean temperature curves obtained by the author for the year and seasons for different values of perihelion, eccentricity and inclination of the ecliptic. Stockwell found for the perihelion of 315° that stronger glaciation occurs with increased eccentricity (*e*) and decreased slope of the ecliptic and it results when $e \not< 0\cdot04$. Farland's results on the disturbances of perihelion and eccentricity for 4×10^6 years are discussed, and they lead to an indication of the run of the ice ages. Values are set out for the changes of temperature in summer and winter for latitudes 40°, 50° and 60° for $e = 0\cdot01677$ and $0\cdot045$, and perihelion of 135° and 315°. These show for increase of eccentricity that the difference of summer and winter temperatures increases and glacial development also. The curves of temperature according to Köppen–Milankovitch and of eccentricity according to the author are set out. The temperature curve tends to lag. The comparison of the curves is discussed for several glacial periods. R. S. R.

1896. Magnetic Measurements on Dykes, and Geophysical Differentiation of Nickel Ore Deposits. F. W. Lee. *Bureau of Mines, Techn. Papers, No.* 10. [18 *pp.*], 1932.—Magnetometer and electrical induction measurements were made over (*a*) a vein in the shape of a dyke, containing pyrrhotine, pentlandite and chalcopyrite, extending to great depth, and (*b*) a diabase dyke containing dispersed magnetite. Both are situated in the N.E. of the Sudbury basin, Ontario, Canada, and are overlaid by about 100 and 200 ft. respectively of glacial drift. As a result it was found that (*a*) was magnetic and conducting, (*b*) magnetic but not conducting. Simple geometrical methods for deducing position from observations are given, and the failure to find any anomalies due to (*b*) by the induction method readily distinguishes it from (*a*). C. A. S.

1897. Spectrum of the Corona. S. A. Mitchell. *Astrophys. J.* 75. *pp.* 1–33, *Jan.*, 1932.—The U.S. Naval Observatory expedition to Niuafoou for the October, 1930, eclipse obtained slitless coronal spectra showing rings with good definition; measurements are given; the wave-lengths are 5302·91, 6374·28 and (new line) 6776; it is noted that the second line coincides closely with one of neutral oxygen. The distribution of "coronium" in position angle is studied; structural details in 5303, resembling eruptive prominences, did not at all resemble those in 6374 or the prominence structure of the flash spectra or direct photographs. The relation of coronal streamers to high-level prominences is discussed. The wave-lengths of 19 "coronium" lines are tabulated with their intensities at eleven eclipses; peculiarities in the observed intensities are numerous and are used with the structural features to group the lines: two pairs are regarded as certain: 3388 and 5303; 3601 and 4086. It is shown that the maximum and minimum types of corona take place about two years earlier than sunspot or prominence maximum and minimum. Absorption is noted at the base of the coronal rings. T. L. M.

1898. Changes in Form of Solar Corona During the 11-Year Cycle. W. E. Bernheimer. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 22*A*. 25. [19 *pp.*], 1932. *In German.*—Ludendorff and Bergstrand have studied coronal changes in form, and found numerical expressions for them, and both have tried to correlate these with changes in sunspot activity throughout the 11-year cycle. A discussion and comparison of their results proves that they differ concerning the period between sunspot maximum and minimum, but the data are scanty and inconclusive for this phase. For minimum and the rise to maximum definite conclusions can be drawn. (1) The greatest amount of flattening of the corona occurs more than a year before minimum, and after this it diminishes gradually until maximum. (2) A close relation exists between the general form of the corona and the average sunspot-numbers for a year, reckoned with the date of observation (eclipse) as central point. The state of sunspot activity during the actual time of observation does not specially affect the form of corona, which seems to change slowly and regularly. This steady change is rendered more probable by the very simple photometric form of the corona, and also by Lockyer's data concerning the progressive change in latitude of prominences during the sunspot cycle, and their correlation with the corona. M. A. E.

1899. Solar Chromosphere. D. H. Menzel. *Lick Observat. Publ.* 17. *pp.* 1–303, 1931.—The material is the Lick moving-plate flash spectra of 1900, 1905 and 1908, on which W. W. Campbell comments in an introduction. Extensive reference tables give wave-length, intensity, classification, etc., for all lines observed; the range is 3229 to 5328 Å., weight in various regions being given in a separate table. Microphotometric intensities at six levels on a relative scale for region 3913 to 4467 Å. are tabulated separately. There are full tables of lines according to element and multiplet. In connection with the data, discussions of the relative value of stationary and moving-plate methods, and of the calibration of intensities, are given. The remainder deals with the physical problems. The theory of absorption line contour is developed and a new generalised ionisation formula obtained, which is more readily handled than Milne's. The chief source of continuous emission and absorption in the solar atmosphere is found to be photoelectric ionisation. Full discussions of the atomic coefficients of general and line absorption are given; in the latter Doppler temperature effect is introduced. The formulæ for intensity of chromospheric emission are approximate; increased importance is given to self-reversal. The principal conclusions from application to the data are: The mean chromospheric temperature is lower than that of the reversing layer by about 1000°; temperature gradients are low. The relative abundance of elements agrees well with the results from the solar spectrum, except for an excess of H and the rare earths. Most of the Fraunhofer absorption originates below the observed chromosphere. The theories of the support of the chromosphere are fully discussed. Numerous other points of importance are raised. T. L. M.

1900. Magnesium Line 5183Å. in the Solar Spectrum. G. Righini. *Accad. Lincei, Atti*, 14. *pp*. 285–287, *Oct.*, 1931.—The author refers to criticisms by Plaskett in a recent paper [see Abstract 4127 (1931)] on the observation of Mg lines. Plaskett comments on a disaccord between the measurements made at Utrecht and by the author at Arceti; but the author considers that this arises from an error of interpretation on the part of Plaskett. The author has repeated his measurements with the microphotometers of Hartmann and of Moll and gives the curves representing the results. These curves agree within the limits of experimental error. J. J. S.

1901. Solar Prominences. E. J. Perepelkin. *Zeits. f. Astrophysik*, 3. *pp*. 338–353, *Dec*. 7, 1931.—It has been shown [see Abstract 786 (1931)] that Ca^+ radial velocities in prominences are greater than those of hydrogen, but that a close correlation exists between them. This is confirmed by the observations of 1930, and research by the writer and others leads to the following conclusions: (1) Prominence velocities usually vary according to the line measured, highest values being given by lines of Ca^+, lower by Balmer lines of hydrogen, still lower by the helium line D3, and lowest of all by metallic lines. This agrees with the theory of radiation-pressure. (2) Most prominences have the same form in different lines, but sometimes they differ, the Ca^+ form having the greatest extent, the H and He less and the metallic the least. This suggests that "quiescent" prominences originate in a quiet welling up of gases from great depths, and metallic eruptions in a more violent uprising, hence we see the same form and velocity in the different elements: it is only when the rising gases are perturbed by selective radiation-pressure that the prominences differ in velocity and form in the different lines. The usually slow rise is confirmed by the usually small velocities and narrow spectral lines; the great depth by the fact that the value of the solar rotation derived from prominences is as great as that from sunspots. (3) Relative intensities between lines of different elements vary, sometimes greatly, in prominences, and probably as velocity increases the number of H atoms relative to Ca^+ diminishes. It is clear that radiation-pressure plays a large part in prominences, but it cannot be the original cause of the quiescent type. M. A. E.

1902. Origin of the Solar System. R. Gunn. *Phys. Rev.* 39. *pp.* 311–319, *Jan.* 15, 1932.—A new account of the formation of the solar system, based on the rotational evolution of a single star, is given which describes the system in some detail and avoids the major difficulties encountered by earlier investigators. Electromagnetic effects have been shown by the author to permit the angular velocity of a star to increase until the star breaks into two components of comparable mass. The component stars are thermally asymmetrical and momentum is radiated more rapidly from the hot face than from the cool. This important new effect, which is quantitatively satisfactory, adds kinetic energy and angular momentum to the companion stars, in a manner analogous to the mechanism of a skyrocket, and may operate to separate the stars to infinity. Applying this to the solar system, the parent semi-liquid sun is supposed to have divided and lost its companion. While each companion was inside the Roche limit of the other, centrifugal and tidal forces broke off the planets. These in turn immediately broke up and formed the planetary satellites. Tides and tidal couples transferred the momentum of axial spin of the two component stars to that of orbital momentum, while the planets because of their small size largely escaped the effects of this process. Planetary rotations play an important rôle in the theory. The account replaces the earlier improbable and " accidental " theory by a systematic evolutionary process which is probably quite common in the universe.

AUTHOR.

1903. New Pyrheliometer for Absolute Measurements. C. Tingwaldt. *Zeits. f. Instrumentenk.* 51. *pp.* 593–599, *Dec.*, 1931.—Comparison of the results obtained by Abbot and Fowle with an absolute instrument and by Ångström with a comparative instrument for solar radiation shows that the latter reads 3·5 % higher due to an edge effect. The author describes a new instrument which gives absolute measurements by a null method. Two similar black bodies are enclosed in adjacent double-walled, but thermally insulated, calorimeters, and the whole enclosed in a large copper vessel contained inside a double-walled vacuum vessel. One black body receives radiation from the sun through a series of slits while the other is protected from solar radiation but warmed by heat generated in water between the walls of the calorimeter, and at such a rate that temperature equilibrium is obtained. Details are given of the dimensions and mounting of the apparatus. Comparisons were made at Davos between this instrument and one of Ångström's type, and the readings had a mean ratio of 1 : 1·018. Thus the results from the American observations must be decreased by 1·8 % to get agreement, but further comparative measurements with the American instrument are necessary.

R. S. R.

1904. Heliostat Without Clockwork. A. Bayle. *Rev. d'Optique,* 10. *pp.* 495–511, *Dec.*, 1931.—Describes a method of causing an instrument —mirror or telescope—to be continuously directed towards the sun or a given star, on which it has once been trained. In the apparatus so far constructed the outfit is utilised to orient a large mirror, which throws light into the somewhat dark rooms of a building. The control of the motors which turn the apparatus is in this case by mercury in hydrogen contactors, actuated by the heat of the sun. If used for following stars, the photoelectric cell would be utilised.

J. H. A.

1905. Nocturnal Atmospheric Radiation at Poona. K. R. Ramanathan and B. N. Desai. *Gerlands Beitr. z. Geophys.* 35. 1. *pp.* 68–81, 1932. *In English.*—Results of measurements of nocturnal radiation at Poona with an Ångström pyrgeometer extending over a year are analysed. The net radiation is a maximum in February and March and a minimum in the monsoon months July to September. Clear skies are also treated separately. In a comparison with results obtained at Benson by Dines, the sky radiation is greater at Poona in each month, but the Poona winter value is smaller than the Benson summer value in spite of its higher temperature probably due to the smaller vapour pressure. Observed values of sky radiation agree generally with those calculated from Ångström's equation [see Abstract **3497** (**1929**)], but they are higher at high and low values of vapour pressure. From May to October the sky radiation on all clear nights reaches a value about 0·75 of the black-body radiation at the surface temperature, the maximum to be expected if water vapour is practically the sole radiating constituent. Tables and curves show the relation between night radiation and the surface temperature inversion. Curves show the influence of the source of the upper air and its resulting vapour content on the sky radiation during the winter months, the levels 2–4 km. being most important, but in the hotter and moister month of May the sky radiation is very little dependent on upper winds. R. S. R.

1906. Variations in Atmospheric Absorption. G. Armellini and Gabriella Conti. *Accad. Lincei, Atti,* 14. *pp.* 545–551, *Dec.* 20, 1931.—With the Toepfer photometer of Campidoglio Observatory a series of observations of Polaris has been made, and when they are grouped into summer and winter observations, and periodical variability, altitude, etc., have been taken into consideration, it appears that atmospheric absorption in Rome is slightly less in winter than in summer. Some planetary magnitudes have also been estimated, and transit observations of Uranus and Neptune have been made. The positions found for these two planets do not exactly agree with those of the *Nautical Almanac*, derived from Newcomb's tables, but their secular perturbations are not yet definitely known. M. A. E.

1907. Halley's Comet in its Apparition of 1909–1911. N. T. Bobrovnikoff. *Lick Observat. Publ.* 17. *pp.* 309–482, 1931.—The general discussion is based on 438 negatives (227, Crossley reflector), 271 reproductions, 77 spectrum observations and all the published material. The greater part of the paper consists of an exhaustive report on all types of observation in chronological order. Wherever possible the motion of matter has been studied (notes on measurement; reduction formulæ) and mean paths determined. Repulsive forces of very varied order are found. Internal transformations of great magnitude are found in certain condensations in the tail. In general, tail motions can only be represented by short tracks under varying repulsive forces, and the data do not support the view that tail motions departed from the orbital plane of the nucleus. Motion in the envelopes shows approximate balance of gravitation and repulsion; in the radius vector produced to a small distance beyond the nucleus, repulsion is found up to 6 × gravitation, in the fine streamers up to several hundred times gravitation. The detailed calculations from the plates of each suitable date are tabulated. Investigations of streamers by others are discussed, and unpublished work by Curtis is included. Measurements of the available spectra are discussed: the CN, Swan and

Raffety bands, evidence for carbon isotopes, D-lines, doubtful evidence of NO, preponderance of CO+ in tail. The CN bands show a large displacement to violet, not a Doppler effect, and evidence of fluorescence excitation is obtained. Fluorescence bands of Na_2 are possibly identified. In concluding sections the expansion of the envelopes (whose shape was not parabolic but corresponded best with a catenary), the variation in size of the nucleus, the expansion of the spherical haloes, the nature of repulsive forces with reference to Bredechin's theory (which is sustained, but not his tail classification) and a number of other points are discussed. T. L. M.

1908. Arizona Expedition for the Study of Meteors. H. Shapley, E. J. Öpik and S. L. Boothroyd. *Nat. Acad. Sci., Proc.* 18. *pp.* 16–23, *Jan.*, 1932.—Harvard Observatory has equipped and organised two meteor stations in Arizona, one on Mars Hill, near the buildings of the Lowell Observatory, and the other 23 miles to the west. At these stations simultaneous and independent observations are made through iron reticules which are projected on the sky, being mounted in the opposite slopes of the roof in a wooden shelter, and these give coordinates of reference for meteor trails which the observers inside the shelter trace on maps. The time of appearance, magnitude and duration are also recorded. These reticule records are supplemented by visual observations of velocities made by means of a specially devised instrument, and by telescopic observations made with two 4-inch instruments 3 km. apart. Besides giving much information about the physical nature of meteors, their frequency at different hours and seasons and in different directions, their heights, etc., this investigation will help to solve the fundamental problem of their origin. For from the distribution of their geocentric velocities and radiant points it is possible to deduce their heliocentric velocities. In the first month a total of 2755 records was obtained by six observers. Heights and real paths can be derived for about 400 meteors which were observed at both stations, and 234 velocity records were registered. M. A. E.

1909. Development of the Disturbing Function with Large Values of the Ratio of the Distances. E. W. Brown. *Roy. Astron. Soc., M.N.* 92. *pp.* 224–227, *Jan.*, 1932.—A further development is given of the method for obtaining rapid convergence of the series which represents any coefficient in the harmonic development of the disturbing function described in a previous paper [see Abstract 2056 (1928)]. Series are obtained which permit of calculation to eight places up to $\alpha = 0 \cdot 91$ and to five places up to $\alpha = 0 \cdot 93$, where α is the ratio of the mean distances of the planets from the sun. J. E. K.

1910. Spectrum of Jupiter. R. Wildt and E. J. Meyer. *Zeits. f. Astrophysik*, 3. *pp.* 354–368, *Dec.* 7, 1931.—The continuous spectrum of Jupiter has been photometrically investigated, and the distribution of luminosity confirms Schönberg's suggestion that the orange colour of the planet is due to a considerable diffusion of light in its atmosphere. The strength of the absorption bands in the infra-red has been measured, and details are given of a newly-discovered band in this region. In the spectrum of Uranus, and also of Neptune, there is a band obscuring $H\beta$ which does not exist in Jupiter. M. A. E.

1911. Gravitational Effect of Radiation on Stellar Structure. G. C. McVittie. *Roy. Astron. Soc., M.N.* 92. *pp.* 55–71, *Nov.*, 1931.—The equation of mechanical equilibrium for a region occupied by matter and radiation of comparable densities is deduced from the equations of general relativity. The resulting equation is applied to the central region, occupied by incompressible matter and radiation of high density, of a stellar model of Milne's "standard" type. The model consists of an outer layer of perfect gas, an inner layer of degenerate gas, and, lastly, the core. The weight of radiation is neglected except in the core. The coefficients of opacity and of energy generation are constant throughout the model. The solution of the equations of fit between core and degenerate-gas zone is obtained. The results are applied to Milne's "centrally-condensed" models, and lead to the conclusion that these models could be finished off at the centre by a core of the type envisaged, as the temperatures there must be so high that radiation-density is at least as great as the matter-density. G. C. McV.

1912. Period-Amplitude and Luminosity-Amplitude Relation in Cepheids. K. Lundmark. *Zeits. f. Astrophysik*, 3. *pp.* 313–337, *Dec.* 7, 1931.—From an examination of 244 Cepheids in several nebulæ and globular clusters, and in the Magellan Clouds, a correlation of amplitude with period and also with luminosity has been traced. It is less marked than the well-known period-luminosity correlation, and none of these can be regarded as mathematically exact laws of physics, but all are valuable for determining the distances of remote objects. M. A. E.

1913. Colour Temperatures of Stars. A Brill. *Zeits. f. Astrophysik*, 3. *pp.* 373–385, *Dec.* 7, 1931.—The temperature determinations of Sampson and of Greaves, Davidson and Martin [see Abstracts 1380 and 3689 (1930)] are compared with one another and their consistency with the author's temperature scale is examined. T. L. M.

1914. Photographic Observations of Double Stars (Second List). W. M. Smart. *Roy. Astron. Soc., M.N.* 92. *pp.* 207–214, *Jan.*, 1932.—The author supplements his previous paper [see Abstract 1566 (1932)] by 263 pairs. As in the first list the right ascensions and declinations are given for 1930·0; the accuracy is of the same order, and the particulars of the table are in all points similar. A. S. D. M.

1915. Bands of CH and CN in Stellar Spectra. P. Swings and O. Struve. *Phys. Rev.* 38. *pp.* 142–150, *Jan.* 1, 1932.—The upper limit of visibility in the spectral sequence of the CH band at λ4300 is found to be F8 (temperature about 6500° K.). This value is considerably lower than has been adopted heretofore (classes F2 to A0; temperatures 7900° to 13,000° K.). The region occupied by the CH band is very rich in strong atomic lines and it is therefore not permissible to consider the general aspect of the Fraunhofer "G-band": the total intensity of the atomic lines greatly exceeds that of the molecular lines. The limit of visibility of the CN band at λ4200 is found to be at F8, in agreement with former estimates. The simultaneous disappearance of CH and CN, having heats of dissociation of 110 and 210 k.cal./mol. respectively, may be explained by the great abundance of H in stellar atmospheres. AUTHORS.

1916. Peculiar Stellar Spectra. Part III. Occurrence of Europium in A-Type Stars. W. W. Morgan. *Astrophys. J.* 75. *pp.* 46–59, *Jan.*, 1932.—Thirteen stars of spectral types A0–A3 have been found which show the two strongest lines of Eu^+. Seventeen other stars have a line in their spectra coinciding in position with the strongest Eu^+ line, which cannot be accounted for by any other element. These stars, together with α^2

Canum Venaticorum, seem to make up a group of "europium stars" in the early subdivisions of spectral type A. AUTHOR.

1917. Mass of 27 Canis Majoris. D. B. McLaughlin. *Astrophys. J.* 75. *pp.* 60–63, *Jan.*, 1932.—It is shown that in range of velocity, length of period, correlation of emission and velocity changes, and in the presence of a secondary oscillation of short period and smaller range than the main period, 27 Canis Majoris is a normal Be spectrum variable. Large variations in the periods of stars of this type rule out the hypothesis of orbital motion, and with it the enormous mass function derived by Struve [see Abstract 4147 (1931)]. The supposed secondary spectrum is also a normal phenomenon of Be variables, and is due to a wing of the broad absorption which underlies and borders the emission lines. AUTHOR.

1918. Doppler Effects in Hydrogen Canal Rays of Uniform Energies. H. F. Batho and A. J. Dempster. *Astrophys. J.* 75. *pp.* 34–39, *Jan.*, 1932.—Positive ions were produced by bombarding hydrogen with low-voltage electrons from a hot kathode. The ions formed passed beside the kathode into a strong field where they were accelerated by potentials up to 15,000 volts. The ions then passed into an observation chamber, where the light emitted by the accelerated particles was photographed with a large three-prism spectrograph. With the usual canal-ray tubes broad displacements are obtained as Doppler effects due to the velocity distributions in the ions, maxima are sometimes present suggesting ions of various masses, and the observed displacement is always considerably less than that calculated from the potential difference on the tube. With the present tube sharp displaced lines of the Balmer series are obtained indicating homogeneous velocities, the displacements agree with those calculated from the potential for atomic ions, molecular ions and triatomic molecular ions. These ions break up in the observation chamber giving hydrogen atoms which emit the Balmer series lines with Doppler effects corresponding to the velocities of the ions. At low pressures the displaced line due to the molecule ion becomes the strongest as suggested by previous experiments on the positive-ray analysis of ionisation products. **T. R. Hogness**, in a note, suggested that the double absorption lines observed in some Novæ might be of similar origin. Rough measurements of spectra of two Novæ gave pairs of velocities approximately as $\sqrt{2} : 1$ in each case. If this is correct it indicates an electrical origin for the expanding shell of gas. R. d'E. A.

1919. Stellar Aberration and Red Shift. G. van Biesbroeck. *Astrophys. J.* 75. *pp.* 64–65, *Jan.*, 1932.—The position of a distant nebula, which has shown a large recessional velocity, has been measured photographically in order to ascertain if the yearly aberration has the same value for the nebula and for the surrounding stars. No measurable difference was found, showing that the high velocity of the source does not affect the velocity of the light. AUTHOR.

1920. Dark Nebula Surrounding ρ Ophiuchi. R. Müller. *Zeits. f. Astrophysik*, 3. *pp.* 369–372, *Dec.* 7, 1931.—In continuation of the work on photographs of the southern Milky Way taken at La Paz [see Abstract 1162 (1932)], star counts have been made in another dark region on the borders of Ophiuchus and Scorpio. They indicate the presence of an absorbing cloud with a thickness of about 700 parsecs, and a mean distance from us of some 500 parsecs. M. A. E.

LIGHT.

1921. Thermal Colour Change of Cobalt Chloride in Pyridine Solution. I. Rohde and E. Vogt. *Zeits. f. phys. Chem.* 15. *Abt.B.* 4–5. *pp.* 353–364, *Jan.*, 1932.—The absorption spectrum of $CoCl_2$ in pyridine solution is measured spectrophotometrically between − 45° and + 105° C. The change of colour from red to blue observed between + 10° and + 50° C. is found to correspond to changes in the absorption spectrum which proceed over the whole temperature range. These consist, not of a continuous variation of the absorption of a single molecule type, but of a temperature variation of the equilibrium between two molecule types, each of which has an absorption spectrum independent of temperature, without intermediate forms. The temperature variation of the extinction coefficient at $\lambda = 6100$ Å. corresponds quantitatively to the monomolecular reaction $Co_{Red} \rightleftarrows Co_{Blue}$, with a heat change of 11,700 cal. A solution appearing blue at 50° C. still contained 90 % of Co_{Red}, the proportion not falling to 50 % until 97° C. C. B. A.

1922. Prediction and Verification of Difference Between Colours of Stereoisomers. Pauline Ramart-Lucas and (Miss) Biquard. *Comptes Rendus,* 194. *pp.* 187–189, *Jan.* 11, 1932.—The absorption spectra of ethylenic, *cis-* and *trans*-stereoisomers are determined, not by the double bond, but by the spatial disposition of the chromophoric groups in the molecule. A racemic and an inactive form of saturated cyclic *cis-* and *trans*-isomers should have different " colours." The spectra of five such pairs examined show two absorption bands, one of which is the same for each isomer, while the other varies from one isomer to the other. C. B. A.

1923. Basis of Dependence of Visual Acuity on Illumination. W. W. Wilcox. *Nat. Acad. Sci., Proc.* 18. *pp.* 47–56, *Jan.*, 1932.—The paper is written from the point of view of the experimental psychologist, and gives the results of a set of experiments designed to test the hypotheses of Hecht and of Houstoun on this subject. The least interval between two narrow parallel vertical bars was measured, for which they were seen as separate objects, under a wide variety of illumination conditions. The bars and their background were separately illuminated, but were of the same colour. Monocular vision was employed and the field was viewed through a small aperture so as to eliminate the effect of dilatation and contraction of the pupil of the eye, as the intensity of illumination was altered. With bright bars on a dark ground, the threshold passes through a minimum at a certain intensity; with dark bars on a bright ground, the minimum is much less marked, and occurs at a higher intensity. The results suggest a new hypothesis, that positive or negative irradiation is responsible for the variation of threshold with intensity, and this is quantitatively tested. J. H. A.

1924. Photoelectric Visibility Measurements. Part I. L. W. Pollak and W. Gerlich. *Gerlands Beitr. z. Geophys.* 35. 1. *pp.* 55–65, 1932.—A description is given of methods used to measure and register visibility by day and night by photoelectric cells. The cell is more reliable than the eye and equally sensitive. In order to make it possible to use

Goldberg's wedge method and Wigand's movable diaphragm without a highly sensitive galvanometer, the new Tungsram photo-element (copper-oxide cell) is used. H. M. B.

1925. Refractive Dispersion of Gaseous Hydrocarbons. S. Friberg. *Zeits. f. Physik*, 73. 3–4. *pp.* 216–222, *Dec.* 2, 1931.—The refractive indices of ethane and propane for 15 wave-lengths between 5800 Å. and 2300 Å. are investigated by the method of Koch. The differences between the observed values and those calculated from simple dispersion formulæ do not exceed 0·01 %. Particular attention is paid to the purity of the gases, since very minute quantities of impurity are shown to have a marked effect on the refractive indices. C. B. A.

1926. Circular Dichroism and Chemical Bonds. J. P. Mathieu. *Comptes Rendus*, 193. *pp.* 1079–1081, *Nov.* 30, 1931.—If the link between the chromophore and the active group is homopolar the compound exhibits the Cotton effect; if it is heteropolar, it does not do so. This is confirmed by observation of a solution formed by dissolving freshly precipitated chromium hydroxide in tartaric acid cooled to 0° C. The strength of the solution was such that it contained 1 gm.-atom of chromium for every 3 gm. mol. of tartaric acid. If observed immediately it was made, the chromium salt was normally ionised, and there was no Cotton effect. Left to itself, the colour slowly changed, and the chromium became part of a complex anion, involving a homopolar link. The circular dichroism characteristic of the Cotton effect appeared at the same rate as the transformation occurred. A. C. M.

1927. Optically Active Properties of Inorganic Compounds. W. Kuhn and A. Szabo. *Zeits. f. phys. Chem.* 15. *Abt.B.* 1. *pp.* 59–73, *Dec.*, 1931.—Great similarity is exhibited between the optically active behaviour of inorganic and organic compounds, and the present paper relates to the absorption, circular dichroism and rotation of potassium chromium tartrate solutions. The data are compared with the published results for $[Co(NO_2)^{en}_{2pn}]Br$, $[Cr(C_2O_4)_3]K_3$ and $[Co(C_2O_4)_3]K_3$, whereby it is established that the rotatory power of these products is connected with single weak absorption bands whose intensity only amounts to about a millionth part of the total optical absorption of the product. The ultra-violet absorption bands appear to contribute still less to the rotation in the case of the inorganic than in the organic substances. For the spatial extension of the scattering moment, distances are given which exceed by tenfold the usual molecular diameters, a determination which is perhaps related to the phenomena of thixotropy and with observations in photochemistry. H. H. Ho.

1928. Ultra-Violet Rotatory Dispersion of α- and β-Pinenes in Alcohol Solution. R. Servant. *Comptes Rendus*, 194. *pp.* 368–369, *Jan.* 25, 1932.—Measurements of rotatory dispersion of the pinenes, previously made as far as 3130 Å., are now extended to 2650 Å. The rotation of α-pinene is found to become increasingly negative as the region of absorption is approached. It passes through a minimum and begins to increase again beyond 2800 Å. The rotation of β-pinene changes sign at about 3850 Å., reaches a maximum at 2800 Å., and then returns rapidly to negative values. A minimum is also observed in the blue of the visible spectrum. C. B. A.

1929. Influence of Diphenylamine, Aniline and some Derivatives on the Birefringence of Nitrocelluloses. A. Michel-Levy and H. Muraour. *Comptes Rendus,* 194. *pp.* 372–373, *Jan.* 25, 1932.—A continuation of previous work [see Abstract 2036 (1930)]. A thin section of an American nitrocellulose powder containing more than 11·7 % of nitrogen, and initially of negative birefringence, is treated under the polarising microscope with diphenylamine in alcoholic solution. As the alcohol evaporates and saturation is approached, the birefringence becomes zero and then increases rapidly to positive values. Re-dilution with alcohol restores the negative birefringence, so that the process is reversible. The same phenomenon is observed in other powders with various nitrogen contents. Aniline produces the same effect as do also mono- and diethylaniline, though more slowly in that order. No effect is observed with diethyl centralite, camphor, phenyl urea, tetramethyldiaminodiphenylmethane or ammonia. C. B. A.

1930. Paramagnetic Rotatory Power, at Very Low Temperatures, of the Double Nitrate of Cerium and Magnesium, and of Two Minerals Containing Manganese (Spessartite and Dialogite). J. Becquerel, W. J. de Haas and J. van den Handel. *K. Akad. Amsterdam, Proc.* 34. 9. *pp.* 1231–1243, 1931. *Comm. No.* 218*a from the Phys. Lab., Leiden. In French.*—The paramagnetic rotations of parasite and tysonite have been shown to be due to cerium [see Abstract 1174 (1931)]. At the temperature of liquid helium, the rotation produced in the double nitrate of cerium and magnesium is only of the order of 1 % of that in tysonite, while it varies *linearly* with the field. Little variation with temperature is observed between 1·5° and 20·3° K. It is suggested that the low value may be due to the smallness of the magnetic moment ($<0{\cdot}2$ Bohr magneton) in the initial state of the absorbing ion. The paramagnetic rotations of spessartite and dialogite approximate closely to the hyperbolic tangent form with moments of less than 2 magnetons, probably about 1 magneton. These results thus disagree with the theories of Hund, Laporte-Sommerfeld and Bose-Stoner which attribute to the Mn^{++} ion a moment of 5 magnetons, observed in various manganese salts. C. B. A.

1931. Rotatory Polarisation of Ferromagnetic Substances. O. Halpern. *Ann. d. Physik,* 12. 2. *pp.* 181–184, *Jan.* 2, 1932.—The rotatory polarisation of ferromagnetic substances has previously been attributed to an internal magnetic field which, in order to obtain agreement with experiment, must be of the same order of magnitude as the Weiss field. An attempt is now made to show how such a magnetic double refraction is to be expected from the Heisenberg theory of ferromagnetism, although no magnetic field of the suggested magnitude exists. C. B. A.

1932. Magneto-Optical Analysis. F. Allison. *Indust. and Engin. Chem.* (*Analytical Ed.*), 4. *pp.* 9–12, *Jan.*, 1932.—Principally a review of the magneto-optical method of analysis, with an outline of the results which have so far been obtained and of possible further applications in the fields of: (1) qualitative analysis, and especially the detection of traces; (2) quantitative analysis, in which the sensitivity is of the order of one part in 10^{11}, the sample is not affected by the determination and other substances do not interfere; (3) the study of isotopes; and (4) the detection of intermediate compounds in certain reactions. As regards (3) it is noted that the differential time-lags of the isotopes of an element appear to vary directly rather than inversely with the atomic masses of the individuals, and that the number of minima does not always exactly equal the number of known isotopes. Recent work [unpublished] has shown that the magnitudes of the galvanometer deflections corresponding with the 3 isotopes of lead are in approximately the same proportions as reported for the abundance of the isotopes; in addition, evidence has been obtained of a fourth isotope of atomic mass 205 or less. Work in progress includes the examination of the selective absorption of isotopes by plants. The two very close minima observed with water and many acids suggest that two isotopes of hydrogen exist, of which the lighter is several thousand times more abundant than the heavier; the mass of the heavier isotope is probably 2. H. F. G.

1933. Theory of Kerr Effect in Wave Mechanics. T. Neugebauer. *Zeits. f. Physik*, 73. 5–6. *pp.* 386–411, *Dec.* 10, 1931.—The disturbance theory of Dirac's equation is generalised for *n* particles, and the Heisenberg-Kramers dispersion formula deduced from this theory. The Kerr effect is then calculated according to these. A comparison is made of this formula with that of the Langevin–Born–Gauss molecular orientation theory and with the theory of Voigt, and also a determination of the limits of their validity and of the correspondence of the representative terms. A half-classical formula is deduced which can be used in those cases in which the classical formula fails. The meaning of the Kerr effect is considered in symmetrical atoms and molecules according to quantum mechanics, while according to the classical theory it should disappear. The formula obtained is compared with the results of experiment. J. J. S.

1934. Electric and Magnetic Double Refraction. J. W. Beams. *Rev. Modern Physics*, 4. *pp.* 133–172, *Jan.*, 1932.—Descriptions are given of the Kerr and Cotton–Mouton effects and of the methods available for measuring the respective constants. The theories of Havelock and of Langevin–Born for the Kerr effect are outlined, as well as the quantum mechanical theories of Kronig and of Born–Jordan. The various effects observed in gases are described, and are treated from the points of view of Langevin–Born (Kerr effect) and of Voigt (Cotton–Mouton effect). The Langevin–Born theory is applied to both effects in liquids, and their relationship to the optical and electrical properties of molecules is discussed. The theory of Raman and Krishnan for dense liquids is developed and applied to the use of the Cotton–Mouton effect in the determination of crystal structure. The variations of both Kerr and Cotton–Mouton constants with wave-length, temperature and density are investigated, and the measurement of the absolute values n_p and n_s is described. The theory and uses of the relaxation time of the Kerr effect are given, and also an outline of both phenomena as observed in liquid mixtures, suspensions, colloids, crystalline liquids, amorphous solids and crystals. C. B. A.

1935. Lustre of Plane Surfaces of Transparent Minerals. A. Johnsen. *Preuss. Akad. Wiss. Berlin, Ber.* 24. *pp.* 497–505, 1931.—The author shows that the lustre of plane surfaces of minerals can be stated in terms of the expression given by Fresnel in 1821 for the intensity of the light reflected from the surface. For monochromatic unpolarised light the lustre can be quantitatively defined in terms of the refractive index and angle of incidence. In the case of simply-refracting crystals, *e.g.*, cubic crystals or non-crystalline minerals, values of the lustre are derived which increase with increasing refractive index, n, for constant angle of incidence not exceeding the polarising angle. The same holds for angles greater than the polarising angle, but $< 79^\circ$ provided $n < 5 \cdot 14$. For greater angles of incidence and polarising angle between 79° and 80°, the lustre coefficient goes through a series of maxima and minima for increasing refraction index. Doubly-refracting crystals do not lend themselves to anything like such simple treatment. J. S. G. T.

1936. Molecular Scattering of Light in Solid Bodies. Part IV. Intensity of Scattered Light in Rock-Salt. G. Landsberg and S. L. Mandelstam, Jr. *Zeits. f. Physik*, 73. 7–8. *pp.* 502–510, *Dec.* 30, 1931.—The Gans theory is developed only for isotropic bodies and is therefore only approximately true for quartz while the agreement obtained by the author [see Abstract **993** (1930)] appears to be accidental. Rock-salt is isotropic optically, although not for elasticity, but it has no combination scattering and is better for testing the theory. The intensity of light scattered by rock-salt is determined by comparison with that for a sample of quartz of approximately the same dimensions and having scattering of the same order of magnitude. The crystal was freed from strain by heating and suitably polished and the refractive index determined in benzene using essentially the same experimental arrangements. The effects of scattering due to want of homogeneity are found by temperature changes. The ratio $J_{\mathrm{NaCl}}/J_{\mathrm{quartz}}$ obtained by experiment is 0·69, while the Gans theory gives 0·935 and the Einstein theory 1·70, but the deviations are outside the errors of experiment. Theoretical considerations show that the Gans theory is not quite correct. R. S. R.

1937. Diffraction Patterns due to Small Circular Apertures. L. R. Wilberforce. *Phil. Mag.* 13. *pp.* 154–160, *Jan.*, 1932.—The results of the examination made by Lommel (in 1884–86) of the diffraction effects produced on a screen by the light from a point-source passing through a circular aperture are restated in simple form. Photographs are given showing how the character of the pattern depends only upon the number of half-period elements transmitted by the aperture. A number of photographs show the effects obtained when the aperture transmits less than one half-period element; it is believed that this is the first publication of such photographs. A. H.

1938. Circles and Strips. P. Strehl. *Zeits. f. Instrumentenk.* 52. *pp.* 19–25, *Jan.*, 1932.—Numerical evaluation is required for many optical questions including interference and diffraction fringes as large or small circles and narrow or wide strips, in order to determine the true relations which exist. For a given set of symbols the various values for transverse sections are tabulated for circles of different radii and strips of different width. An accuracy of 5 % is claimed and in some places of 1 %. The applications of these tables to the images obtained for Venus, Mercury, spots on Jupiter's moons, spectral lines and other quantities are given. R. S. R.

1939. Interference Optical Lever for Pressure Gauges, Galvanometers, etc. W. E. Roseveare. *Am. Chem. Soc., J.* 54. *pp.* 202–205, *Jan.*, 1932.—A simple optical system is described by means of which it is possible to measure deflections of a 3-m. optical lever with an average error of about 0·003 mm. An all-glass optical lever pressure gauge incorporating this system has an observational error of 0·006 mm. pressure and withstands an atmosphere pressure in either direction. Another gauge withstanding 10 cm. pressure has an observational error of 0·0002 mm. pressure. A. H.

1940. Secondary Conjugate Surfaces. T. Smith. *Optical Soc., Trans.* 32. 4. *pp.* 129–149, 1930–1931.—Examples are given of conicoids which satisfy the secondary object-image relation for refraction at a spherical surface with a small stop. The special cases where the conicoid degenerates into two planes are considered. It is shown that if the object conicoid is of this type the image conicoid is only similarly degenerate in a trivial case, and the image of a plane is therefore a portion of a conicoid Refraction at the vertex of a single thin lens leads to relations of the same general character. The inclusion of simple results of this type in courses on geometrical optics is suggested as a corrective to the usual assumption that the image of a plane is itself a plane. General relations are given between the curvatures of object and image curves lying in any axial plane formed by axial refraction at a combination of thin lenses. AUTHOR.

1941. Graphical Constructions for a Refracted Ray. T. Smith. *Optical Soc., Trans.* 32. 4. *pp.* 150–158, 1930–1931.—Two groups of spherical or plane conjugate surfaces can be found for refraction at any point of a sphere, and they give rise to distinct methods of constructing a refracted ray. Snell's construction is a special case of one group, and Young's a special case of the other group. Other cases of interest are examined. By inverting these two groups other constructions are obtained. AUTHOR.

1942. Astigmatism of the Oblique Pencil Refracted by a Spherical Dioptric Surface. M. Dufour. *Comptes Rendus,* 194. *pp.* 365–367, *Jan.* 25, 1932.—A new simple derivation of the classical formula. [See also Abstract 3110 (1930).] C. B. A.

1943. Laws of the Second Order in Simply-Symmetrical Optical Systems. M. Herzberger. *Zeits. f. Physik,* 74. 1–2. *pp.* 88–109, *Jan.* 22, 1932.—In systems with one plane of symmetry, as distinguished from rotation-systems, the images are characterised by defects of the second order. The author classifies these defects, eight in number, into three groups: defects in aperture, in definition, and in the form of the image. To these he adds two magnitudes, due to the diaphragm. He thus obtains a simple formula, which shows the relations between the defects of the image and the positions of the object and diaphragm. He works out the relations as depending on the relative slopes of the object, the diaphragm and the screen. A. D.

1944. Wedge Spectrograms Without an Absorbing Wedge. O. E. Miller. *Rev. Sci. Instruments,* 3. *pp.* 30–42, *Jan.,* 1932.—By means of suitably shaped diaphragms used in conjunction with a cylindrical condenser spectrograms equivalent to wedge spectrograms are produced without the use of an absorbing wedge. The essential advantages of wedge spectrography are retained and the method is of definite quantitative value, being of use for the determination of characteristic curves, etc. The suggestion is made that the instrument will be readily convertible into a photographic spectrophotometer. A. H.

1945. Penta Comparison Prism for Spectroscopes. S. D. Bryden, Jr. *Rev. Sci. Instruments,* 3. *p.* 51, *Jan.,* 1932.—A penta prism placed before the slit of a spectroscope eliminates the objections to this method of simultaneously observing the comparison and unknown spectra. The penta comparison prism is preferably mounted on a vertical slide before the slit instead of on the usual hinged bracket. AUTHOR.

1946. Hansen's Intensity-Mark Apparatus. P. H. van Cittert. *Zeits. f. Physik,* 73. 3–4. *pp.* 249–252, *Dec.* 2, 1931.—Hansen [see Abstract 1355 (1925)] published a method for obtaining marks of graded density by using a diaphragm having a series of apertures of different length which ran into one another stepwise. It is shown that this method can only be applied when the slit is fairly wide; in spectroscopes, for example, the slit width is too narrow, and systematic errors of say 20 % can enter. Furthermore, if the region of the spectrum investigated is one for which the prism material is partially absorbing, errors arise through the varying thickness of the prism. A. C. M.

1947. Photoelectric Polariscope. D. R. Morey. *Rev. Sci. Instruments,* 3. *pp.* 24–29, *Jan.,* 1932.—To investigate polarisation properties of radiations too weak to be handled with the common visual devices for the purpose, a photoelectric device is used. A nicol of good quality, with end faces perpendicular to the length is mounted on a cæsium vacuum cell, and this, together with the working valve of a two-valve bridge amplifier, placed in a brass container free to rotate about an axis passing through the centre of the nicol. Control apparatus and the dummy valve and batteries are located in a stationary container, connections being made through a flexible shielded cable. The galvanometer deflection obtained is proportional to the intensity of the component of the radiation able to pass through the nicol. The percentage of polarisation has been measured with illuminations down to 10^{-5} foot-candle. When applied to rotation measurements, a rotation of the plane of polarisation of one second of arc can be detected. AUTHOR.

1948. Photoelectric Microphotometer using Valve Amplification. C. S. Beals. *Roy. Astron. Soc., M.N.* 92. *pp.* 196–207, *Jan.,* 1932.—This new instrument, from the Dominion Astrophysical Observatory, is direct-reading and employs as a recording system a valve amplifier [see Abstracts 3306 (1928) and 2935 (1930)] in conjunction with a galvanometer scale (a Leeds and Northrup F4447 type B; it is considerably curved, and the image of a vertical lamp filament is used as an index). It is similar in principle to that built by Hesthal and Harrison. The valves are of type Ux201A with a plate impedance of about 10,000 ohms. The photoelectric cells are Visitron type A.V. gasfilled. Diagrams are given of the electrical system [see Abstract 81 (1928)] and of the microphotometer, and descriptions of the optical system and the method of recording. The instrument allows limited spectral regions to be studied, accurate measures to be taken both of high and of low densities, high resolving power for the measurement of narrow lines and precise wave-length determination for the spectral region measured. The zero is steady but there is a slow creep during the run; the sensitivity can be varied within wide limits, and 6 methods for this are available; the present resolving power is greater than that of the photographic plate so that a slit width of at least 0·2 mm. must be used; the speed of adjustment and the time of making a run of 300 readings is about 45 to 60 min. and the accuracy increases with the more rapid run. The author gives two examples, with diagrams, of the actual measurement:

(1) the contour of the emission band λ4686 in the Wolf-Rayet star, H.D. 192163, showing complicated structure on the top of the band like that in Novæ and the asymmetrical character of the band which is perhaps due to absorption on the violet edges [see Abstract 1795 (1930)]; (2) the contours of interstellar calcium lines H and K, and of hydrogen (H_ϵ) in H.D. 30614; he compares the intensity ratio K/H with that found by Unsöld, Struve and Elvey [see Abstract 785 (1931)] and finds them accordant—indeed actually the same value though this is probably accidental.
A. S. D. M.

1949. Photoelectric Photometer for X-Ray Intensities. E. Dershem. *Rev. Sci. Instruments,* 3. *pp.* 43–50, *Jan.,* 1932.—Describes a photoelectric microphotometer for measuring the intensities of the lines on a plate exposed to an X-ray spectrum or to a single line with different absorptions. The cell used is of the potassium hydride type, and the system of measurement of the photoelectric current is the electrometer-leakage circuit. Examples of the application of the instrument are described.
J. W. T. W.

1950. Diffuse Reflection Factors. A. Boutaric. *Rev. d'Optique,* 10. *pp.* 485–494, *Dec.,* 1931.—There are four factors which may be used to describe the diffusing properties of a material for reflected light. These are (*a*) the reflection factor for a definite angle of incidence α and a definite angle of reflection α'; (*b*) the reflection factor d_α for a definite angle of incidence α, but irrespective of the angle of reflection, *i.e.*, the *total* flux reflected expressed as a fraction of that incident at the angle α; (*c*) the reflection factor $\delta_{\alpha'}$, which expresses the flux reflected at an angle α' as a fraction of the *total* incident flux, considered to be perfectly diffused; and (*d*) the diffuse reflection factor as ordinarily defined. The author obtains mathematically the relations between these various factors. In particular he finds that $d_\alpha = \pi\delta_\alpha$ as the relation connecting (*b*) and (*c*) when $\alpha = \alpha'$.
J. W. T. W.

1951. Photographic Activity of Slow Kathode Rays. V. Weidner. *Ann. d. Physik,* 12. 2. *pp.* 239–264, *Jan.* 2, 1932.—In this paper the photographic activity has been investigated of kathode rays of velocity range 0–1100 volts upon various silver bromide emulsions. The essential results obtained are: (*a*) The validity of the reciprocity law is in general confirmed, but in certain cases deviations have been observed. (*b*) The darkening curves of gelatin plates exhibit retarded growth of the darkening with amount of charge. (*c*) The darkening curves of plates poor in gelatin indicate a far-reaching linear growth of the darkening with electronic charge. (*d*) A survey is given of the course of photographic sensitivity with ray velocity; the initial sensitivity of the gelatin deficiency plates increases linearly with ray energy above 60 volts, whilst at 60 and 35 volts distinct stages of sensitivity are obtained. The smallest ray velocity for which photographic action can be discerned is 22 volts. Considerable specific data are included.
H. H. Ho.

1952. Optical Sensitisation in Photography. W. D. Bancroft, J. W. Ackerman and Catharine A. Gallagher. *J. Phys. Chem.* 36. *pp.* 154–173, *Jan.,* 1932.—Vogel's work (1873) on the sensitisation of silver bromide plates by certain dyes, Carey Lea's criticisms of Vogel's conclusions, and recent communications by Sheppard on this question are discussed. It is now shown that the Grotthus theory enables Vogel's results to be accounted for. In cases in which fluorescence is debarred, an optical sensitiser in photography is a substance which is adsorbed by silver bromide, does not bleed into gelatin sufficiently to form a colour screen and either is a powerful enough reducing agent to produce a latent image with silver bromide when activated by light or is converted by light into a reducing agent sufficiently powerful to produce a latent image with light. In cases so far studied it is probable that the silver bromide is reduced by the activated dye and not by a reaction product. The gelatin, the solid silver bromide, and the sensitivity to light in the absence of dye may be eliminated by using solutions of ferric chloride and of silver nitrate, which may be optically sensitised with a number of light-sensitive dyes. Moreover, a solution of ammoniacal cupric oxide and phenylhydrazine of suitable concentration is stable in the dark and is bleached in the light, and is optically sensitised by sodium eosinate. T. H. P.

1953. Origin of the Broad Absorption and Fluorescence Bands in Dyestuff Solutions. A. Jablónski. *Zeits. f. Physik*, 73. 7–8. *pp*. 460–469, *Dec*. 30, 1931.—The Franck–Condon principle is extended to systems of several degrees of freedom and the system dyestuff molecule-solvent is discussed as an example. It is assumed that variations in density of the solution in the immediate proximity of the dyestuff molecule are the causes of the broadening of the energy-steps. An explanation can then be given of the characteristic appearance of the spectra, of Stokes' rule, of the independence of the intensity distribution in the fluorescence bands of dilute solutions and the dependence for concentrated solutions on the exciting wave-length, of broadening and displacement of the bands with increasing temperature, of Wawilow's law and of the transformation of radiation energy to heat energy. Although the exact form of the bands cannot be calculated the cause of their characteristic asymmetry can be given. From the potential curves one can explain the appearance of fluorescence in particular cases as well as its extermination by small additions of other substances. J. E. K.

1954. Emission of Praseodymium in Earth Alkali Phosphors. H. Evert. *Ann. d. Physik*, 12. 1. *pp*. 107–136, *Dec*. 22, 1931, *and* 12. 2. *pp*. 137–153, *Jan*. 2, 1932.—Praseodymium phosphors were prepared with various bases and their emission studied spectrographically. The results are tabulated. The sulphides show two bands whose lines differ in temperature relations, excitation and sharpness. The two bands are attributed to two different centres. There are also two spectra in the oxides. The shift of the lines from one phosphor to another is attributed to varying contraction of the electron shell of the anion with different binding. The lines of CaO— and SrO—Pr phosphors are arranged in term schemes suggesting that the vibration frequency of the distorted solvent lattice accounts for the frequency differences in the spectra. J. E.

1955. Analysis of Band Spectra of Lenard Phosphors. F. Schmidt. *Ann. d. Physik*, 12. 2. *pp*. 211–238, *Jan*. 2, 1932.—An analysis of the results obtained by various workers. The following generalisations are given: (1) The emission bands belong to the same series as the exciting bands, (2) several bands appear in the same place in both emission and excitation, (3) all Lenard phosphors have the same series of bands independent of the nature of the impurity, and (4) several series can overlap in the same phosphor. Whether the nature of the impurity metal influences

the choice of members of a series or the relative intensities of the members and whether it affects the temperature changes of the spectra cannot be decided from the existing data. Still less can the nature of the emitting centre be deduced from the data. It is therefore necessary that further work be carried out on the emission and absorption spectra of phosphors.
J. E.

1956. What is Radiation? J. Jeans. *Brit. J. of Radiology,* 5. *pp.* 21–37; *Disc.,* 38, *Jan.,* 1932.—This paper, which is the 14th Sylvanus Thompson Memorial Lecture, consists of a critical survey of the various theories of radiation from the Newtonian corpuscular theory to the modern photon theory. The triumphs and failures of each theory are touched on, and it is shown that neither a corpuscular theory nor a wave theory is fully competent to explain the facts, with the suggestion that "the ultimate processes of radiation are so far removed from anything we encounter in ordinary life, that it is impossible to compare them to any objects of common experience." G. E. B.

1957. Absorption Spectra of Rare Earth Double Nitrates. Part II. Dorothy Wyllie and J. A. Harris. *Roy. Soc. Canada, Trans.* 25. *Sect.III. pp.* 107–113, *May,* 1931.—The applicability of repeated recrystallisation of the double nitrates of the cerium group of rare earth metals with nickel, zinc and cadmium to the separation of the rare earths has been examined. The cadmium salts are practically useless, whilst with zinc the degree of separation attained is much the same as with the commonly used magnesium double nitrates, except that lanthanum and praseodymium cannot be separated. The double nitrates with nickel permit a strikingly rapid separation of neodymium and samarium, and appear to provide the best means of effecting this separation. Summarising the results described in the present and previous papers [see Abstract 1217 (1931)]: the magnesium, cobalt and zinc salts give a uniform separation but no marked separation of any one element; fractionation of the ammonium salts appears to be the most efficient means of effecting a preliminary separation of praseodymium from lanthanum and neodymium; the use of the manganese salts is recommended only for the final purification of neodymium from samarium and praseodymium; and the use of the nickel salts for the rapid preliminary separation of samarium is strongly recommended. H. F. G.

1958. Absorption Spectra of Rare Earth Glazes. F. H. Norton and D. T. H. Shaw. *J. Phys. Chem.* 35. *pp.* 3480–3485, *Dec.,* 1931.—The colours of lead metasilicate glazes containing oxides of cerium, praseodymium, neodymium and samarium have been recorded and analysed. On the whole, the positions of the spectral bands correspond with those observed with aqueous solutions, and the rare earths present in a glaze may therefore be identified by the spectrophotometric reflection curve. With the exception, under certain conditions, of cobalt, chromium and uranium, the rare earths are the only elements which yield glazes exhibiting sharp band spectra in the visible region. H. F. G.

1959. Optical Investigations of Perylene and its Derivatives. Part III. Ultra-Violet Absorption Spectrum. H. Conrad-Bilbroth. *Zeits. f. phys. Chem.* 15. *Abt.B.* 1. *pp.* 1–17, *Dec.,* 1931.—The ultra-violet absorption spectra of perylene and of a number of its derivatives [see Abstract 2501 (1929)] show two groups of bands, one of which is attributed to the benzenoid linking and the other to the linking of two aromatic nuclei. On the basis of this arrangement, electronic formulæ are devised for the quinones of perylene. From the distribution of the bands, three nuclear frequencies (1330, 920 and 300 cm.$^{-1}$) in the hydrocarbon are indicated, and a formula is derived which gives the positions of all the maxima. T. H. P.

1960. Near Infra-Red Absorption Spectrum of Methane. J. G. Moorhead. *Phys. Rev.* 39. *pp.* 83–88, *Jan.*, 1932.—The infra-red absorption spectrum of methane between $1\cdot 4\,\mu$ and $2\cdot 6\,\mu$ was obtained with an infra-red spectrometer having a grating of 5000 lines to the inch. Strong bands were found in the $1\cdot 6\,\mu$ and $2\cdot 3\,\mu$ regions. The fine structure of the $2\cdot 3\,\mu$ band was resolved in the first order spectrum. The fine structure of the $1\cdot 6\,\mu$ band was resolved in the second order but not in the first order spectrum. Only at the $2\cdot 20\,\mu$ and the $1\cdot 66\,\mu$ bands could the fine structure be measured. The $2\cdot 20\,\mu$ band has spacing of $10\cdot 7$ cm.$^{-1}$ giving for the value of the moment of inertia $5\cdot 17 \times 10^{-40}$ c.g.s. units. The corresponding values for the $1\cdot 66\,\mu$ band are $10\cdot 4$ cm.$^{-1}$ and $5\cdot 32 \times 10^{-40}$ c.g.s units. These results are quite close to the values of $9\cdot 77$ cm.$^{-1}$ and $5\cdot 66 \times 10^{-40}$ c.g.s. units found for the $3\cdot 31\,\mu$ band by Cooley. AUTHOR.

1961. Absorption of Infra-Red Radiation by Small Particles. A. H. Pfund and S. Silverman. *Phys. Rev.* 39. *pp.* 64–71, *Jan.* 1, 1932. —The absorption of infra-red radiation by small particles of quartz, calcite and ammonium chloride has been studied. For this purpose a special radiometer was constructed, with its vanes coated with the material to be studied. Evidence is brought forth to show that the crystals, when sufficiently finely divided, do not reflect well in their regions of metallic reflection. This offers a simple method of studying the absorption spectra in these regions. In addition, a new type of selective filter employing a radiometer seems possible, with preliminary experiments in accord with expectations. AUTHORS.

1962. Infra-Red Absorption and Reflection Spectra of Calcite. S. Silverman. *Phys. Rev.* 39. *pp.* 72–76, *Jan.* 1, 1932.—The reflection and absorption bands of calcite at $6\cdot 6$–$7\cdot 4\,\mu$ have been studied with an echelette grating spectrometer of high resolving power, employing the resonance radiometer. A great deal of hitherto unobserved fine structure has been detected. It is to be noted: (1) that the maxima of the envelopes of the absorption and reflection bands differ widely in wave-length, as has been previously reported in the literature; (2) that within the bands, there is good agreement as to wave-length between the absorption and reflection lines. Possible explanations of this fine structure are offered, including that of combinations of residual rays (*Reststrahlen*) and near infra-red frequencies. AUTHOR.

1963. Infra-Red Absorption Bands of Water Vapour. E. K. Plyler. *Phys. Rev.* 39. *pp.* 77–82, *Jan.* 1, 1932.—Further experimental work has been done on the near infra-red absorption of water vapour in the regions of $1\cdot 40\,\mu$ and $1\cdot 90\,\mu$. Forty-five lines have been listed for the region of $1\cdot 40\,\mu$. There is some difficulty in interpreting this band as to zero branch or double type. By using somewhat higher resolution the $1\cdot 87\,\mu$ band has been shown to consist of more lines than previously observed. The region of $1\cdot 87\,\mu$ has the appearance of a double-type band when a small amount of water vapour was used. Calculations have been made as to the form of the water vapour molecule on the assumption that this is the third fundamental band of water vapour. Also, the intensities of the bands have been calculated and these are found to be in good agreement with the experimental values. A new classification has been made of the combination bands. AUTHOR.

1964. Infra-Red Absorption Spectra of Benzene and Homologues. P. Lambert and J. Lecomte. *Comptes Rendus*, 194. *pp.* 77–79, *Jan.* 4, 1932.—The registering spectrometer previously described [see Abstract 132 (1930)] is used to investigate between 6 μ and 16 μ a number of homologues of benzene. A new band is found in benzene at $14 \cdot 8\ \mu$, of such intensity that a few microns of the liquid give total absorption. When an aliphatic side chain is introduced into the benzene nucleus, two bands appear; one at $16 \cdot 6\ \mu$ attributed to the side chain, and one at $14 \cdot 4\ \mu$ attributed to the nucleus. The substitution of several CH_3 groups for H atoms in the nucleus gives differences according to the substitution-positions sufficiently clear to make it possible to distinguish between isomers in a mixture, possibly quantitatively. Similarities are found in the spectra of *m*-xylene and mesitylene, and in those of *o*-, *m*-, *p*-xylene and pseudocumene. Completely different spectra are obtained from positional isomers where the aliphatic radicals are in the side-chain or all in the nucleus; *e.g.*, ethylbenzene and the xylenes. A. C. M.

1965. Light Emission from Metallic Vapours in the Positive Column. H. Krefft. *Phys. Zeits.* 32. *pp.* 948–950, *Dec.* 1, 1931.—Comments on various experimental observations on the radiation from metal vapours in discharge tubes. The behaviour of the alkaline metals is dealt with as well as that of several other metals including Cs and Tl. At small vapour pressures the resonance series chiefly appears, with alkali metals the chief series, but in that series the intensity falls off very quickly. In all metal vapours in the positive column an approach to the emission of band spectra of the most various kinds is noticeable. J. J. S.

1966. Different Modes of Excitation of Light in Discharge Through Gases. E. Lau and O. Reichenheim. *Ann. d. Physik*, 12. 1. *pp.* 52–65, *Dec.* 22, 1931.—The authors describe an improvement in their method [see Abstract 3529 (1930)] for finding the excitation voltages of spectral lines, by means of observations at the border between the Faraday dark space and the positive column. The improved apparatus makes it possible to investigate the emission of light which is due to other causes than collisions with electrons. Effects were found in the excitation spectra which are to be explained as due to the dissociation of H_2 into an excited and an unexcited atom (Franck and Blackett effect). Light emission due to metastable states was also observed. These states (atoms) can either cause foreign atoms to send out light by collisions of the second kind, or can themselves be raised to higher states by collision with electrons, or absorption of light, and can then give off light. The emission of light due to irradiation was also studied, and it was shown that the concentration of excited non-metastable atoms can be just as large as that of the metastable states. A resonance of the second order can build itself up on these excited terms. H. N. A.

1967. Structure of the Hg Line 5461 Å. E. Lau. *Ann. d. Physik*, 12. 1. *pp.* 66–68, *Dec.* 22, 1931.—This paper is a supplement to that of

Lau and Reichenheim [see preceding Abstract]. Janicki, McLennan and Nagaoka in studying the above line used a cooled arc lamp as source. Lau and Reichenheim have found that the principal lines in light from this source are reversed, owing to the instability of the ground term. Thus the existing analysis cannot have given the physical character of the pure emission. The author has now employed a mercury vapour lamp filled with hydrogen, in which the metastable state gives up its energy to H_2 in collisions of the second kind, causing dissociation of the H_2. The appearance of the resolved Hg 5461 Å. line is very different from that found previously. The relative intensities of the different lines are very different indeed, and in particular the intensities of the component lines at a distance from the most intense line are very greatly reduced. The position of the most intense line is greatly shifted. The relation of the new results to the question of the isotopes of mercury, which has been recently treated by Schüler, is under consideration. H. N. A.

1968. First Spark Spectrum of Mercury. B. Venkatesachar and T. S. Subbaraya. *Zeits. f. Physik*, 73. 5–6. *pp.* 412–418, *Dec.* 10, 1931. —Through comparison of the behaviour of the lines 2262, 2053 and 2027 in the mercury arc at low gas pressure the line 2262 was explained as transition $^2D_{5/2} - {}^2\overline{D}_{5/2}$. The constant difference 1457 between the wave numbers 2262 and 2339 which in a number of cases is repeated led to the identification of the four ^2D terms which belong to the configuration $5d^96s7s$ and of a "shifted" series of the type of that found by Paschen in neon, which in general arises with the corresponding ordinary series out of the configuration $5d^96pnp$ (n = 6, 7, 8 and so on). The $^4\overline{P}$ terms corresponding to the configuration $5d^96s6d$ were also found. With help of the new terms 76 further lines could be arranged in order. J. J. S

1969. Continua and "Forbidden" Series in the Sodium Arc Spectrum. H. Bartels. *Zeits. f. Physik*, 73. 3–4. *pp.* 203–215, *Dec.* 2, 1931.—The blue-green discharge previously observed in a special type of sodium vacuum arc lamp [see Abstract 2516 (1924)] is now further examined spectroscopically. The lamp is re-designed to work with high currents (30 amperes). The spectrum obtained shows (1) strongly developed limit continua in the subsidiary series and the principal series; (2) the "forbidden" PP-combinations throughout the subsidiary series. The (2P–mP) doublets have nearly equal intensities throughout while the intensity of the neighbouring (2P–mD) series falls off from member to member. The forbidden transitions appear to be favoured as the series limit is approached. The transition of the line series into the continuum is studied closely and two new characteristic continua are observed in the middle of the subsidiary series, for which no explanation has been found. C. B. A.

1970. Magnetic Rotation Spectrum and Heat of Dissociation of the Potassium Molecule. F. W. Loomis and R. E. Nusbaum. *Phys. Rev.* 39. *pp.* 89–98, *Jan.* 1, 1932.—The magnetic rotation spectrum of the near red, $^1\Pi - {}^1\Sigma$ band system of K_2 has been photographed with the apparatus previously used for Li_2 [see Abstract 802 (1932)]. In this way the series of upper vibrational levels has been extended from the 16th, the last one observed by Crane and Christy, to the 27th. This permits an accurate extrapolation to convergence, which is estimated to occur at $v' = 31\cdot6$, the corresponding energy being 17,160 cm.$^{-1}$ = 2·12 volts. It follows that the heat of dissociation of the normal molecule is 0·51 ± 0·02 volt. From this and other data the percentage of molecules in the vapour at various temperatures is calculated. An improved Franck–Condon diagram for the red and infra-red systems of K_2 has been constructed. It gives a good representation of the observed distribution of bands and predicts the existence of an infra-red edge. This is confirmed by observation. Magnetic rotation spectra have been found in the regions of the infra-red and blue $^1\Sigma$–$^1\Sigma$ systems. They are probably analogous to the red magnetic rotation spectrum of sodium, and like it, are not yet understood. AUTHORS.

1971. Arc Spectrum of Copper. C. W. Allen. *Phys. Rev.* 39. *pp.* 42–63, *Jan.* 1, 1932.—The behaviour of certain lines was examined with a 3-prism spectrograph of 25-ft. focal length using pressures up to 80 atmospheres. Certain conclusions are drawn concerning the breadth of lines; and it is concluded that it is an inner property of the Cu atom and not due to external disturbance. Intensity measurements were also made on the same lines using a quartz spectrograph and currents up to 19 amperes. The results are discussed in relation to predictions from the sum rule. F. S.

1972. Spectrum of Doubly Ionised Cerium. A. S. King and R. B. King. *Mt. Wilson Observat. Contrib. No.* 441. *Astrophys. J.* 75. *pp.* 40–45, *Jan.*, 1932.—The spark spectrum of cerium, when excited by a very intense discharge, shows in the near ultra-violet many strong lines not found in the arc spectrum, in which the lines of CeII are prominent. The writers have measured 280 lines of this character from λ2167 to λ3544 and noted their intensity and degree of diffuseness. These spark lines probably belong for the most part to doubly ionised cerium, although 5 of the lines measured have previously been ascribed to CeIV. AUTHORS.

1973. Extension of Spectra Al II, MgI, BeI and Al I. F. Paschen. *Ann. d. Physik*, 12. 4. *pp.* 509–527, *Jan.* 21, 1932.—In analogy with the BeI spectrum, the spectra of Al II and MgI are discussed with reference to the relation of the deepest P-state to the $3p4s$ and $3p3d$ terms. The significance of strong line groups is considered, especially one such group in BeI. The Al I spectrum is discussed with relation to analysis of CII by Fowler and Selwyn. F. S.

1974. Two-Electron Spectrum of Boron, BII, and the Irregular Doublets of the Series BeI to OV. B. Edlén. *Zeits. f. Physik*, 73. 7–8. *pp.* 476–481, *Dec.* 30, 1931.—New measurements of the BII spectrum are made and the term analysis is considerably extended. The ionisation potential (2^1S_0) is calculated to be 25·007 volts and the metastable ground term of the triplet system (2^3P_2) lies 4·58 volts higher. Comparison with the known terms of BeI shows how well these (with some notable exceptions) fit in with and complete the homologous series BII, CIII, NIV and O.V. J. E K.

1975. Spectra of Two- and Three-Valence-Electron Atoms, SiII, PIII, SIV, SiIII, PIV and SV. I. S. Bowen. *Phys. Rev.* 39. *pp.* 8–15, *Jan.* 1, 1932.—New measurements of the vacuum spark spectra of Si, P and S have been made with a vacuum spectrograph. With the aid of these data it has been possible to analyse a large number of hitherto unclassified lines. In SiIII and PIV the stronger singlet lines have been classified, while in these ions and in SV a large number of lines involving

terms in which both electrons are excited have been identified. In SiII, PIII and SIV many of the important quartet lines have been located.
AUTHOR.

1976. Theory of Complex Spectra. Part I. Energy Levels. M. H. Johnson, Jr. *Phys. Rev.* 39. *pp.* 197–209, *Jan.* 15, 1932.—A general method of finding the wave function for LS coupling which is similar to that of Gray and Wills is described. The successive transformations which carry the angular momentum matrices, S^2, L^2 and J^2 to a diagonal form, are determined by writing down these matrices in terms of the unperturbed wave functions and solving the resulting linear equations for the transformation coefficients. This yields the wave functions appropriate for LS coupling. The method is applied to give the wave functions for all the states of LS coupling with the smallest value of $|M_J|$ in the following electronic configurations: p^2, d^2, p^3, p^2s and p^3s. The matrix of the spin-orbit interaction is calculated with these wave functions and is factored according to J values because J^2 is an integral of the motion. By adding the electrostatic energies as computed by Slater's method to the diagonal elements (the electrostatic energy is known to be a diagonal matrix in LS coupling), the complete energy matrix is obtained. Setting the determinant of the matrix equal to zero, the secular equation for each J value is found for the above electronic configurations. These equations determine the position of the energy levels in intermediate coupling provided that second order perturbations may be neglected and provided magnetic effects other than the spin-orbit interaction do not contribute appreciably to the Hamiltonian. AUTHOR.

1977. Transmission Band of Silver. S. Schubin. *Zeits. f. Physik*, 73. 3–4. *pp.* 273–280, *Dec.* 2, 1931.—Attempts to explain the presence of a transmission band in silver, by means of simple considerations connected with the quantum optics of metals. In particular the questions of the position of the band in the spectrum, its relation to temperature and the possibility of the occurrence of a similar band in the absorption spectra of other metals are briefly discussed. H. N. A.

1978. Graphical Representation of Results of Band Spectroscopy. R. Rydberg. *Zeits. f. Physik*, 73. 5–6. *pp.* 376–385, *Dec.* 10, 1931. —A regularity in the course of the nuclear vibration differences, ΔG, of diatomic molecules is exhibited by representing $(\Delta G)^2$ as a function of the vibrational quantum number, v, of the nuclei. If $(\Delta G)^2$ is plotted logarithmically against B_v instead of against v a straight line graph through the origin is obtained leading to the equation $(\Delta G)^2_v = k \, . \, B^3_{v+1}$, where $B_v = (h/8\pi^2)(I/\mu r^2)_v$. A graphical method is developed for constructing the potential curves of H_2, CdH and O_2 from the action-integrals and the B_v values. J. E. K.

1979. Band Spectrum of Zirconium Oxide. F. Lowater. *Phys. Soc., Proc.* 44. *pp.* 51–66, *Jan.* 1, 1932.—The spectrum of ZrO has been photographed from λ2600 to λ8800, and bands have been found to extend from λ3200 to λ7600. The most prominent bands have been analysed into three systems, all having the same lower electronic state; the blue system α is probably due to a transition $^3\Pi \rightarrow {}^3\Pi$; the yellow system β and the red-infra-red system γ are probably due to transitions $^3\Sigma \rightarrow {}^3\Pi$. Analysis of the remaining bands is in progress. AUTHOR.

1980. New Atmospheric Oxygen Band at λ7710. R. Mecke and W. Baumann. *Zeits. f. Physik*, 73. 3–4. *pp*. 139–146, *Dec*. 2, 1931.—The atmospheric oxygen band, appearing in the solar spectrum only when the sun is low at λ7710, is explained as a $v', v'' = 1, 1$ band; 38 lines belonging to it have been measured. The combination relations of this band show that Mulliken's term rule $^3\Sigma \rightarrow {}^1\Sigma$ is correct. The nuclear frequency of the ground state $\omega_0(1 - 2x) = 1556 \cdot 405$, and $B'' = 1 \cdot 4375 (1 - 0.0111v'')$. The probability of jumps $1 \rightarrow 1$ relative to jumps $0 \rightarrow 0$ is estimated as 0·8, which agrees with expectation. The ratio between the intensities of the two A bands in the solar spectrum is found to be $A_{00} : A_{11}$ as 6000:1. H. N. A.

1981. Intensity Distribution in the Band Spectrum of Helium. C. W. W. Read. *Roy. Soc., Proc.* 134. *pp*. 643–657, *Jan*. 2, 1932.—The region λ6100 — λ6500 of the band spectrum of He_2 was investigated. The intensity relations in the band λ6400 are considered in detail. The results show that in this case an expression of the type $\log (I/C\nu^4 i) = (E/T) \log e^{-1/K}$ is sufficient to represent the relative intensities of the band lines throughout a given band. Here the quantum number K is the resultant of Λ the projection of the electronic momentum on the nuclear axis and *m* the rotational quantum number, Hund's notation being used. The statistical weight of a level K is proportional to (2K + 1) provided it is observed that alternate levels (even) are suppressed. The results indicate that the assignment of K values must be correct, otherwise the existing agreement between predicted and experimental intensity values would not occur. J. J. S.

1982. Red CN Band System. F. A. Jenkins, Y. K. Roots and R. S. Mulliken. *Phys. Rev.* 39. *pp*. 16–41, *Jan*. 1, 1932.—The bands were excited in carbon tetrachloride vapour mixed with active nitrogen and were photographed with a 21-ft. grating. The rotational structure of the (4, 1), (5, 2), (6, 1), (6, 2), (7, 2), (7, 3) and (8, 3) bands was measured and the lines are arranged in eight branches, giving a structure characteristic of a $^2\Pi \rightarrow {}^2\Sigma$ transition in which the spin doubling in $^2\Sigma$ is small. Three strong perturbations are found exactly as expected from those found in Rosenthal and Jenkins' violet bands. From measurements of the R_2 heads of 17 other bands, the following expression is obtained for band origins:

$$\nu = 11043 \cdot 20 + 1788 \cdot 66(v + \tfrac{1}{2}) - 12 \cdot 883(v' + \tfrac{1}{2})^2 - 2068 \cdot 79(v'' + \tfrac{1}{2}) + 13 \cdot 716(v'' + \tfrac{1}{2})^2.$$

F. S.

1983. Normal Vibrations of Acetylene. A. R. Olson and H. A. Kramers. *Am. Chem. Soc., J.* 54. *pp*. 136–138, *Jan*., 1932.—The linear vibration model of the acetylene molecule suggested by Mecke [see Abstract 461 (1931)] is discussed, and modifications suggested which require a revision of Mecke's correlation with experiment. F. S.

1984. Molecular Spectra and Spectroscopic Analysis. Part II. Lanthanum. G. Piccardi and A. Sberna. *Accad. Lincei, Atti*, 15. *pp*. 83–88, *Jan*. 3, 1932.—The absorption spectrum cannot be used for lanthanum, as it is in the case of the coloured rare earths, but its spark spectrum may be studied, if the concentration of La is not too small, and if the spectra of the other elements present are not too rich in lines. The most persistent lines are at 3949·10, 3171·7 and 2379·4 Å. They are found with 0·01 % solutions, but not at ten times this dilution. When a more sensitive method is required, as in examining a mixture of rare earths, where lines of other elements within 0·1 Å. of the La lines will be present, the monoxide may be used. This is prepared by heating the sesquioxide, and is very stable. To obtain the spectrum of LaO, the solution containing a salt of lanthanum is introduced as a spray into a stream of oxygen and fed into a gas burner. A suitable spray has been specially designed. The method can just detect lanthanum in a 0·005 % solution of lanthanum nitrate. The band system is described in detail; part of it is in the visible, which makes examination extremely simple. J. H. A.

1985. Hyperfine Structure of the Mercury Resonance Line 2537 Å. Part II. S. Mrozowski. *Acad. Polonaise Sci. et Lettres, Bull. No. 6A. pp.* 489–521, *June,* 1931. *In German.*—The hyperfine structure of the mercury resonance fluorescence excited by filtered mercury-arc radiation is investigated. The lower 1^1S_0 level of the mercury atom is found to be unsplit. Observations on the influence of the addition of foreign gases upon the resonance radiation show that the hyperfine structure components − 25·4, − 10·4 and + 21·5 mÅ. belong to one and the same kind of isotope and that the components 0 and + 11·5 mÅ. belong to different kinds of isotopes. Investigation of the parallel Zeeman effect in absorption in fields up to 15 kilogauss leads to the discovery of at least four new components. On the grounds of the Zeeman-effect observations the fivefold structure of λ2537 is interpreted as an overlapping of two triplet components with two of the four normal components. The triplet has anomalous intensity ratios. It is attempted to ascribe the various hyperfine components of λ2537 to the various mercury isotopes. [See Abstract 1917 (1931).] J. E. K.

1986. Hyperfine Structure of Mercury. Part III. K. Murakawa. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 346. *pp.* 299–306, *Jan.,* 1932. *In English.*—The investigations of the hyperfine structure of mercury lines communicated in two previous papers [see Abstract 862 (1932)] are extended to the three yellow lines 5769·6, 5790·7 and 5789·7 Å. The hyperfine terms of Hg^{199} and Hg^{201} in the level 6^3D_1 do not satisfy the law of the centre of gravity. The line 3984 of HgII shows a large displacement of the even isotopes. The central part of λ5461 has been re-photographed and measured and is found to be in agreement with the measurements of Schüler and Keyston. The lines 4347, 4339 and 6123 of HgI are partially analysed. J. E. K.

1987. Polarisation of Mercury Resonance Radiation. L. Larrick and N. P. Heydenburg. *Phys. Rev.* 39. *pp.* 289–293, *Jan.* 15, 1932.—The polarisation of the line 2537 Å. of mercury in resonance radiation is calculated on the assumption that isotopes 199 and 201 have nuclear moments of 1/2 and 3/2 respectively, while the even isotopes 198, 200, 202 and 204 have zero nuclear moment as Schüler and Keyston have suggested. With " broad line " and "narrow line " sources respectively, resonance radiation excited by light polarised with the electric vector parallel to the magnetic field should be 84·7 % and 88·7 % polarised, in fair agreement with the observations of Olson, 79 to 86 %, and v. Keussler, 79·5 %. Relative transition probabilities within a hyperfine multiplet are calculated on the assumption of LJS type coupling between J, F and I. AUTHORS.

1988. Polarisation of Resonance Radiation and Hyperfine Structure: Cadmium Resonance Lines. A. Ellett and L. Larrick. *Phys. Rev.* 39. *pp.* 294–298, *Jan.* 15, 1932.—The cadmium resonance lines 2288 and 3261 Å. excited by unpolarised radiation in a magnetic field parallel to the exciting light beam are found to be 76·3 % and 86–87 % polarised respectively. From spectroscopic evidence Schüler has assigned nuclear moments of 0 and 3/2 to the even and odd isotopes of Cd. Separations in 2288 are small compared to Doppler breadth, while in 3261 the strong component of the 3/2 isotope pattern merges with the 0 isotope line. If we suppose that the introduction of spin does not change the net transition probabilities between the gross levels concerned these polarisation values both yield 2·53 for the ratio of abundance of even and odd isotopes. A recent calculation of Mitchell [see Abstract 4209 (1931)] leads to other results, but is based on the apparently incompatible assumptions that intensities in the source are proportional to the isotope abundance, but in absorption are determined by assigning equal weights to Zeeman levels making absorption by the spin isotope twice that by the non-spin isotope for equal abundance and uniform spectral distribution, conflicting with Kirchhoff's law. AUTHORS.

1989. Determination of the Mechanical Moment of the Cæsium Nucleus from the Hyperfine Structure of Some Cs+ Lines. H. Kopfermann. *Zeits. f. Physik,* 73. 7–8. *pp.* 437–451, *Dec.* 30, 1931.—The hyperfine structures of nine Cs+ lines in the visible part of the spectrum are investigated with a Fabry-Pérot étalon. The line components are analysed into term schemes and application of the Landé interval rule leads to a most probable value I = 7/2 for the mechanical moment of the Cs nucleus. J. E. K.

1990. Anomalous Fine Structure and Isotope Displacement in the Cl+ Spectrum. S. Tolansky. *Zeits. f. Physik,* 73. 7–8. *pp.* 470–475, *Dec.* 30, 1931.—Lines of the Cl+ spectrum, which have an *s*-electron term, are investigated for fine structure, but contrary to theoretical expectation no hyperfine structure is found. The suggested explanation is that the *g*(I) factor for the Cl nucleus is unusually small, since the nuclear spin I = 5/2 is already known from band spectrum analysis. An isotope displacement is observed which is bigger than required by the simple Bohr theory. J. E. K.

1991. Zeeman Effect and Λ-Type and Spin Doubling in the CaH Bands. W. W. Watson. *Phys. Rev.* 39. *pp.* 278–288, *Jan.* 15, 1932. —A more detailed discussion of the Zeeman effect in the 6389 Å. $^2\Sigma$, $^2\Sigma$ band of CaH than that given previously with W. Bender is presented [see Abstract 3734 (1930)]. General agreement with the assumption that the magnetic energy in a $^2\Sigma$ state is largely due to the interaction of the electron spin and the external field is obtained for band lines of low K value, but marked differences and asymmetries in the patterns occur for lines from the higher rotational levels. The neglected coupling between the component ρ of L along the rotational axis of the molecule and the field will account completely for these deviations, and these observations together with those on the Zeeman effect of the lines of these higher rotational levels in the $^2\Pi$, $^2\Sigma$ band of CaH are shown to be in accord with the explanation by van Vleck and Mulliken and Christy of the large Λ-type and spin doubling in these states. AUTHOR.

1992. Third Order Terms in the Theory of the Stark Effect. M. A. El-Sherbini. *Phil. Mag.* 13, *pp.* 24–28, *Jan.*, 1932.—The author has obtained the third order terms, using the methods of wave mechanics. The effect of these terms has little or no experimental significance at present, yet the work has some theoretical interest. In each of the two previous approximations a new mode of vibration appears, corresponding to the loss of a degree of degeneracy. With the third order approximation the system is already non-degenerate, and no new frequency should appear. This is actually the case. The third like the first order terms affect the spectral lines symmetrically. H. N. A.

1993. Raman Effect in Non-Ideal Binary Solutions and in Certain Alcohols. R. E. Whiting and W. H. Martin. *Roy. Soc. Canada, Trans.* 25. *Sect.III. pp.* 87–98, *May*, 1931.—The Raman spectrum of an ideal solution contains only the lines of the pure components. Non-ideal solutions are studied (*i.e.*, solutions of which the vapour-pressure is not proportional to the molar composition) and a pyridine–acetic acid mixture is chosen. If in a non-ideal solution association of the two components takes place, then the Raman spectrum might contain extra lines above those of the components, due to this associated compound. Photographs were made of the spectra of pyridine, acetic acid and a mixture of ⅓ mol. pyridine with ⅔ mol. acetic acid. The spectrum of the mixture was an exact superposition of the spectra of the components. The same was true of a mixture of acetone and CS_2. Raman spectra are photographed of various substances to see if the strong continuous background is a result of high viscosity in the case of glycerin. The background is absent in the case of ethylene glycol, although it is almost as viscous as glycerin. Elimination of dust caused almost complete disappearance of continuous portions from the spectra of methyl alcohol, ethylene glycol and a viscous solution, but it remained in the case of glycerin. Dextrose gave a continuous background attributable to decomposition. A. C. M.

1994. Raman Spectrum of Sulphuric Acid and the Action of an Electric Field upon it. V. Ricca. *Accad. Lincei, Atti*, 14. *pp.* 288–290, *Oct.*, 1931.—Experiments were made to determine whether there exists an action of the electric field on the Raman effect. A list of the wave-lengths of the Raman lines is given. The results of the author's observations are uncertain and are to be repeated. It is possible that the widening of the lines may be due to a Doppler effect. The effects observed on the Raman lines may be due in part to the motion of the H^+ ions in the direction of the field and in part to the orientating action of the electric field on the ions. J. J. S.

1995. Raman Spectrum of Sugar Solutions. V. Polara. *Accad. Lincei, Atti*, 14. *pp.* 293–298, *Oct.*, 1931.—In the Raman spectrum of solutions of sugar there occur five of the seven lines of glycerin and four lines which are found in alcohol; in it besides there occur the various types of bands that in the molecular structure of the compounds of the fatty series correspond to particular Raman lines. J. J. S.

1996. Raman Spectra of Pyridine and Acetic Acid. P. Krishnamurti. *Indian Journ. Phys.* 6. *pp.* 367–387, *Nov.* 30, 1931.—Infrared spectra of liquids show a large number of absorption maxima, of which only a few have counterparts in Raman spectra. Examination of the Raman spectra of pyridine and acetic acid has revealed a very large

number of new lines, and the complete spectrum shows all the frequencies found by Coblentz as infra-red absorption maxima. Each liquid is studied with two filters, (1) a dilute solution of the sodium salt of *o*-cresolphthalene to weaken the 4046 group of mercury, and (2) a dilute solution of uranine to weaken the 4358 group. Visual comparison of the relative intensities on the two plates allows assignment to the proper exciting line.
A. C. M.

1997. Raman Effect and Formation of Hydrates. P. Krishnamurti. *Indian Journ. Phys.* 6. *pp.* 401–412, *Nov.* 30, 1931.—Aqueous solutions of pyridine, acetic acid and methyl alcohol are examined over a wide range of concentrations and the Raman frequencies compare with those of the pure liquids. Pyridine solutions show striking changes in the positions and intensities of many lines, reaching a maximum at about 70 % pyridine, corresponding to the hydrate $C_5H_5N, 2H_2O$. Comparison with pyridine hydrochloride solution shows that the water molecules are attached to the N atom in the same way as HCl itself. Acetic acid shows marked changes in the $C = O$ frequency at 1667 $cm.^{-1}$. Maximum charge corresponds to the monohydrate. Methyl alcohol behaves similarly, a dihydrate being indicated. The changed frequencies are all active ones.
A. C. M.

1998. Raman Effect for Benzene Substitution Products. R. W. Wood. *Phys. Rev.* 38. *pp.* 2168–2175, *Dec.* 15, 1931.—Improved technique is described, together with the results of its application to the investigation of the Raman spectra of benzene, toluene, *o*-, *m*-, and *p*-xylene, brom-benzene, diphenyl oxide, diphenyl and diphenyl sulphide. Wrong allocations in these spectra by various authors are corrected. Two photographs of each substance are taken, using in one a noviol-quinine filter (4358 effective) and in the other case a noviol-iodine filter (4047 effective). The two photographs are differently enlarged, so that the lines due to 4358 can be brought into coincidence with those due to 4047 when the two photographs are placed side by side with the two exciting lines coinciding.
A. C. M.

1999. Raman Spectra of Carotinoids. H. v. Euler and H. Hellström. *Zeits. f. phys. Chem.* 15. *Abt.B.* 4–5. *pp.* 342–346, *Jan.*, 1932. —Raman spectra have been measured and classified as far as possible for ethereal solutions of α-carotin, β-carotin, xanthophyll, lycopin and β-ionone.
H. H. Ho.

2000. Relative Efficiency of Mercury Arc Lines in Exciting the Raman Spectrum of Benzol. Magna Werth. *Phys. Rev.* 39. *pp.* 299–310, *Jan.* 15, 1932.—A study of the Raman spectrum of benzol obtained by a modification of Wood's method was made to ascertain whether or not Raleigh's fourth power law ($I \propto \nu^4$) holds when light is scattered by a substance whose Raman spectrum, excited at ordinary temperature and pressure by a 220-volt quartz Cooper-Hewitt mercury arc, contains very few anti-Stokes lines. The Raman frequencies observed are: Δν 606, 845, 992, 1175, 1585, 1603, 2947, 3060, 3185. When the patterns for the exciting lines 3650, 3654, 3663, 4047, 4078, 4108, 4339, 4347 and 4358 Å. were mapped out from the Raman lines observed on the spectrograms many lines were missing, usually due to coincidence with other Raman lines or arc lines. This coincidence made it difficult to decide what fraction of the observed intensity should be allotted to each of the components of lines of double and triple origin; therefore only lines of single origin are considered in this investigation. The relative intensities of the Raman patterns (different shifts for the same exciting line) have been measured. Results show that the intensities of the Raman shifts 845 and 2947 of single origin verify Rayleigh's fourth-power law in the spectrum region 3650 to 5461. AUTHOR.

2001. Fine Structure of Raman Lines. A. Langseth. *Zeits. f. Physik,* 72. 5–6. *pp.* 350–367, *Oct.* 21, 1931.—Raman spectra of CCl_4, $SnCl_4$, CBr_4, $POCl_3$ and SO_2Cl_2 are made under high dispersion (8 Å. per mm. in the green-blue). In the spectrum of CCl_4 the lines 218 and 314 cm.$^{-1}$ are resolved into doublets, and the line 458 cm.$^{-1}$ into a triplet. The triplet resolution is attributed to the isotopes of chlorine, and the separations agree with the calculation on the basis of this frequency being an inactive one. The doublets are not explicable in this fashion, but comparison with the spectra of other tetrahedral molecules makes it probable that the source of this splitting, as well as that of the fourth frequency, into 762 and 791 cm.$^{-1}$, is the probable departure of the CCl_4 molecule from the regular tetrahedral shape. The influence of asymmetry is discussed, and it seems probable that the asymmetry belongs to the type C_2^v, which means that the four valencies of the carbon atom are only identical in pairs. This asymmetry may possibly explain hitherto unsolved problems in the infra-red spectra of methane and carbon-dioxide. A. C. M.

2002. Raman Lines under High Dispersion. P. L. Mesnage. *J. de Physique et le Radium,* 2. *pp.* 403–412, *Dec.,* 1931.—Raman spectra are observed for C_6H_6, $CH_3 . C_6H_5$, $C_2H_2Cl_4$, CCl_4, CS_2, with three spectrographs; (*a*) an ordinary Hilger glass instrument, a 1-m. grating, and a 1-m. autocollimating two-prism instrument. Widths of certain lines are measured, and some have been shown to be double or treble; *e.g.,* the benzene line at 990 is found to be double, 992·4 and 981·1, while in toluene it is treble, 1003·8, 990·9, 977·0. A. C. M.

2003. Circular Polarisation of Raman Lines. A. Kastler. *Comptes Rendus,* 193. *pp.* 1075–1079, *Nov.* 30, 1931.—Certain Raman lines, scattered longitudinally, are polarised in the same sense as the incident circularly polarised light, others in the inverse direction. The inverse lines in the longitudinal effect are those strongly depolarised in the transverse effect. If this rule is applicable to rotation lines, then it is to be expected that Q bands should be circularly polarised in the same direction as that of the incident light, while the P and R bands should be oppositely circularly polarised. It is shown that this is to be expected, by applying the principle of the conservation of angular momentum to the process of light scattering. In a note on Raman scattering in magnetic fields, **A. Cotton** stated that magnetic fields of 46,300 gauss have been applied to nitrobenzene, and the state of polarisation of the scattered lines due to vibrations parallel and perpendicular to the magnetic field has been observed. The lines 1112, 1342 and 1587 are clearly enhanced in the spectrum of vibrations parallel to the field. The lines 1112 and 1587 are also slightly enhanced in the spectrum of the vibrations perpendicular to the field. The unmodified lines are unaffected by the field. A. C. M.

2004. Circular Polarisation in the Raman Effect. J. Cabannes. *J. de Physique et le Radium,* 2. *pp.* 381–391, *Dec.,* 1931.—When Raman scattering is observed longitudinally, excited by light polarised circularly, sometimes the scattered light is similarly polarised (regular) in other cases in a reverse direction (inverse). This is linked to the observations at right angles with plane polarisation. If, in the latter case, depolarisation is small, in the circular case the regular scattering is found, while if the depolarisation is large, the circular polarisation is inverse. This is shown to be in accordance with the simple classical explanation of light scattering. **Errata,** *ibid.*, p. 42, Jan., 1932. A. C. M.

2005. Anomalous Depolarisation of Raman Lines in Uniaxial Crystals. J. Cabannes and (Miss) D. Osborne. *Comptes Rendus,* 193. *pp.* 1410–1412, *Dec.* 28, 1931.—Some Raman lines scattered by calcite have a depolarisation exceeding unity [see Abstract **2463** (1929)]. It is here shown that the results obtained relative to the external frequencies of vibration in calcite are in agreement with results deduced from the Kramers–Heisenberg theory. A. C. M.

2006. Polarisation of Raman Lines in Liquids. J. Cabannes and A. Rousset. *Comptes Rendus,* 194. *pp.* 79–81, *Jan.* 4, 1932.—If $[\alpha]$ is the tensor defining the refractivity of an anisotropic molecule, then the derived tensor $\frac{\partial}{\partial q}[\alpha]$ determines the intensity and polarisation of a Raman line, where q is one of the normal coordinates. From this it is deduced that if a molecule possesses elements of symmetry, and during the normal vibration corresponding to q the molecule does not conserve all its original symmetry, then the depolarisation of the corresponding Raman line is 6/7. Lines possessing depolarisations less than 6/7 correspond to symmetrical vibrations, while no line has a depolarisation in excess of 6/7. These deductions are confirmed by polarisation experiments on liquids of the types XCl_4, XCl_3. The quantitative agreement is not good when the low values of depolarisation are calculated. A. C. M.

2007. X-Ray Determination of Particle Size. F. K. Mayer. *Kolloid Zeits.* 57. *pp.* 353–359, *Dec.,* 1931.—The paper consists of a short outline of the various methods of determining particle size by means of X-rays. The formulæ of Scherrer and Laue, with Brill's correction, for the determination of particle size from powder photographs, are explained. The method of Brill and Pelzer which is independent of line-breadth is also described. Finally the determination of particle size from Laue photographs is discussed. J. T.

2008. Use of X-Rays in the Study of Pearls. B. W. Anderson. *Brit. J. of Radiology,* 5. *pp.* 57–64; *Disc.,* 64, *Jan.,* 1932.—The difficulties of distinguishing real and cultured pearls by means of such physical properties as density, etc., are discussed, and it is shown that identification is easy by means of X-ray photographs of the powder type. Radiographic methods fail on account of the general similarity between the true pearl and the mother-of-pearl nucleus. Genuine natural pearls, examined by the " powder " method, show a marked hexagonal symmetry, while cultured pearls show a fourfold symmetry. The diffraction pattern of several other precious and semi-precious stones is also discussed. G. E. B.

2009. Quantitative Analysis of Alloys by X-Ray Spectroscopy. C. E. Eddy and T. H. Laby. *J. Phys. Chem.* 35. *pp.* 3635–3638, *Dec.,* 1931.—In a recent paper [see Abstract **2847** (1931)] Terrey and Barrett have given an account of quantitative analysis carried out by the method of X-ray emission spectra. It is the present authors' experience that correct analyses can only be made by this method provided certain conditions are fulfilled, and they now submit a detailed consideration of the above paper in which they deal with the X-ray tube, the measurement of exposures, the photographic method of measuring line intensities, the effect of absorption and the theoretical discussion. Data are included for the alloys copper in zinc, tin in cadmium, lead in bismuth, and zinc in zinc-copper-tin, the X-ray analysis and chemical analysis on comparison being found to exhibit particularly good agreement. H. H. Ho.

2010. Kathode-Ray Tube in the X-Ray Spectroscopic Analysis of Columbium and Tantalum. G. R. Fonda. *Am. Chem. Soc., J.* 54. *pp.* 115–122, *Jan.*, 1932.—Using molybdenum as a comparison element calibrations and analyses have been carried out for tantalum and columbium in tantalites and mixtures of oxides and carbides. There is an absolute error in the analyses of about 2 %. For the elements examined differences in intensity of the Lα doublet are found to exist depending upon the nature of the chemical compound and upon the angle of the specimen. No similar differences in intensity are found for the Kα doublet. F. J. W.

2011. International Comparison of X-Ray Standards. L. S. Taylor. *Bureau of Standards, J. of Research*, 8. *pp.* 9–24, *Jan.*, 1932.—Direct comparisons between the X-ray ionisation standards of the United States, England, Germany and France are described. The small guarded-field ionisation chamber was used as the working standard and transported to the several laboratories. Careful check of the instrument calibration at each laboratory showed no change due to transportation. Complete corrections were made for air absorption, differences in current measurements and differences between chamber diaphragms. The final agreement between the standards of the United States, England and Germany was ± 0·5 %. The ratio between the International Röntgen and Solomon's unit for hard radiation (H. V. L. greater than 0·75 mm. Cu) was 2·29. As a result of diaphragm discrepancies found in England, a study of diaphragm measurements was made. It was found that the diaphragms tended to warp with age rendering difficult an accurate determination of their area. Plug gauge and micrometer microscope measurements were averaged for the final results. AUTHOR.

2012. X-Ray Wave-Lengths by Dispersion in Quartz. J. A. Bearden. *Phys. Rev.* 39. *pp.* 1–7, *Jan.* 1, 1932.—It has been shown that the quantum theory of dispersion accounts satisfactorily for the measured refraction of X-rays. Since the X-ray wave-lengths as determined by crystals and by ruled gratings differ by 0·25 %, the dispersion may be used to indicate which of these values is correct. Precise measurements of the refraction of the copper and molybdenum K series in crystal quartz have been made. Both possible methods of using a prism were used. The 90° edge of the prism was very carefully prepared. The results obtained show very close agreement between the wave-lengths as determined by dispersion and by crystals. The apparent precision obtained in the ruled grating measurements is so high that the present results must indicate a failure of the optical diffraction theory when applied to X-ray wave-lengths. AUTHOR.

2013. Variation in the Effective Lattice Constant of Crystals with Wave-Lengths. J. M. Cork. *Phys. Rev.* 39. *pp.* 193–196, *Jan.* 15, 1932.—This investigation is carried out to determine to what extent X-ray

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wave-lengths determined by a calcite crystal are consistent over a considerable wave-length range where the refractive index is known to vary. To this end the reflection angles for particular emission wave-lengths up to 5·5 Å. are observed using a quartz crystal. These angles are combined with corresponding values obtaining with calcite. The values for log $(\lambda(\text{calcite})/2 \sin \theta \ (\text{quartz}))$ when plotted with wave-length, assuming $(1 - \mu)/\sin^2 \theta$ constant for quartz, result in a curve showing the variation due to calcite. A discontinuity exists at the wave-length of the K absorption edge for calcium. The nature of the curve is in agreement with a similar one obtained by Larsen from measurements of the index of refraction. The discontinuity is in the sense to be expected from the dispersion theories of Kallmann and Mark and Kronig. Assuming quartz as ideal in the range 1 to 5 Å., measurements with a calcite crystal are not inconsistent by as much as one-third of 0·1 %. AUTHOR.

2014. New Lines in the K Series of X-Rays. W. Duane. *Nat' Acad. Sci., Proc.* 18. *pp.* 63–68, *Jan.*, 1932.—On photographing the X-rays of molybdenum by the Moseley method, a new line, or rather band, appears a little to the right of the γ line, with wave-lengths that are only very slightly longer than that of the critical absorption. Other fainter new lines also appear. Various interesting possibilities are suggested, of which the most promising seems to be that the new band is due to the conductivity electrons falling into K positions made vacant by the electron bombardment of the target. The new lines, however, will involve a good deal of work, which has been undertaken. A. D.

2015. Absorption Jump at the L-Band Heads of the Heavy Elements. H. Küstner. *Phys. Zeits.* 33. *pp.* 46–49, *Jan.* 1, 1932.—The author has investigated the elements Ba, La, Ce, W, Au, Hg, Tl, Pb, Th and U, using his difference method for producing monochromatic X-rays. For gold Müller foils of thickness amounting to a few microns were employed; for the other elements filter papers soaked in solutions of their salts and dried were used. The author's results are compared with those of Uber, Backhurst and Kellström, and fair agreement is obtained. H. N. A.

2016. Determinations of Atomic Factor in the Region of Anomalous Dispersion. R. Glocker and K. Schäfer. *Zeits. f. Physik*, 73. 5–6. *pp.* 289–311, *Dec.* 10, 1931.—Measurements of the atomic factor by means of iron powder at various wave-lengths between 0·7 and 2·3 Å. show that on drawing near the K absorption edge not merely the absolute value but also the angle distribution is changed. The difference of the atomic factor compared with the value according to Thomas–Fermi increases on the short-wave side of the absorption edge with decreasing angle of scattering, and decreases on the long-wave side. It is constant for wave-lengths far from the absorption edge. The dependence on wave-length is calculated with help of the dispersion theory, and the discrepancies between theory and observation are discussed. The atomic factor of tungsten and of gold for a radiation on the long-wave side of the L absorption edge was determined and comparison made with the theoretical calculation based on dispersion. J. J. S.

RADIOACTIVITY.

2017. Microcalorimetric Measurements of the Period of Polonium. (Miss) A. Dorabialska. *Acad. Polonaise Sci. et Lettres, Bull. No.* 6*A*. *pp*. 522–530, *June*, 1931. *In French.*—Points out some of the difficulties which arise in connection with the ionisation method of measuring the period of a radioactive element. These difficulties do not arise when the adiabatic microcalorimeter is employed. One of the objects of the author was to see if the results obtained by Bogoiavlensky could be verified. He had found that the period of polonium varied very greatly at different stations. The author made measurements at Warsaw and at Zakopane, and, in spite of the fact that there was a difference of level of about 800 m. between the stations, found no difference in the period of polonium. The value obtained was 137·6 ± 0·4 % (in days). H. N. A.

2018. Evaporation of Radium B and Radium C in Hydrogen and Nitrogen. E. Holesch. *Akad. Wiss. Wien, Ber.* 140. 2*a*. 9–10. *pp*. 663–678, 1931.—Describes apparatus in which all the operations necessary to prepare the active deposits from radon, to bring them into and remove them from the electric oven, and to place them in an exact position with respect to the measuring apparatus, can be carried out in atmospheres of pure hydrogen or nitrogen. The RaB and RaC were deposited on a cylinder of polished nickel, since it was found that gold was amalgamated by the mercury in the apparatus, and then melted at a low temperature. It was found that in H_2, RaB evaporates somewhere between 450° and 600° C., and RaC between 400° and 750° C. In N_2 both RaB and RaC begin to evaporate at about 500° C. With RaB in N_2 at 700° C. 85 % is removed from the nickel, while with RaC only 47 % is removed. These values are decidedly smaller than those which have been previously given for evaporation into air, but agree with those of other observers for hydrogen, when the differences in method are considered.
H. N. A.

2019. Range and Velocity of Recoil Atoms. P. M. S. Blackett and D. S. Lees. *Roy. Soc., Proc.* 134. *pp*. 658–671, *Jan*. 2, 1932.—The Wilson cloud method was applied to determine the relation between the velocity and range of H-particles, α-particles, N, O^{16}, O^{17} and A atoms. The method employed was that previously used by Blackett [see Abstract 2211 (1923)], but the large number of new photographs available allows the results to be extended to greater ranges and velocities. Four photographs are given showing elastic collisions with H, N and A. J. J. S.

2020. Charge Carried by Atoms of RaD Emitted by α-Ray Recoil from a Source of RaC on a Metallic Surface. J. D. McGee. *Phil. Mag.* 13. *pp*. 1–23, *Jan*., 1932.—When the source is deposited on a clean nickel or platinum surface one positive unit is carried by each α-ray recoil atom of RaD. The charge carried by a recoil atom is influenced by interaction with the surface from which it escapes. This theory has been extended to correlate the results obtained with those of other observers. The earlier conflicting results were due to the presence of high energy ions. A method of removing these from the beam has been developed, and a possible mechanism for their production is suggested. The small average value of the apparent charge carried by recoil atoms before the source was outgassed is also explained by the presence of ions.

H. N. A.

2021. Scattering of β-Rays. J. A. Gray. *Roy. Soc. Canada, Trans.* 25. *Sect.III. pp.* 57–64, *Dec.*, 1931.—A description is given of experiments which lead the author to conclude that when a β-ray is scattered by an atom it loses energy. This loss of energy is greater the smaller the atomic number of the scattering atom and the greater the angle of scattering. For the same effective angle of scattering the loss of energy is less when the β-ray has been scattered more than once. For very large angles of scattering the intensity of the scattered radiation is not proportional to σ, where $\sigma = mZ/A$, m being the mass/cm.^{2} of the radiator, Z the atomic number and A the atomic weight. The intensity of the scattered radiation is not in general proportional to the inverse second power of the energy of the primary rays. For the scattering to be single a radiator must be so thin that both the intensity and the average energy of the scattered rays are proportional to the thickness of the radiator. J. J. S.

2022. Distribution of Energy in the β-Ray Spectrum of Radium E. F. C. Champion. *Roy. Soc., Proc.* 134. *pp.* 672–681, *Jan.* 2, 1932.—The conditions for the production of a large number of good β-ray photographs, using an automatic expansion chamber are discussed. From Hρ 2400 onwards the energy distribution of the β-ray spectrum of RaE was investigated. The spectrum was found to end sharply at about Hρ 5500. It is estimated that less than 1 particle in 2000 is emitted with Hρ greater than this value. A review of previous experimental results is given and causes of the discrepancy observed are suggested. J. J. S.

2023. Upper Limit of Energy in the β-Ray Spectrum of Thorium C″. F. R. Terroux and N. S. Alexander. *Cambridge Phil. Soc., Proc.* 28. *pp.* 115–120, *Jan.*, 1932.—Using the cloud expansion method [see Abstract 2716 (1931)] slightly modified, the upper portion of the β-ray spectrum of ThC″ shows no "tail," but an end-point at about 9400 Hρ. The few tracks of Hρ 9400–10,800 found are probably of secondary origin [see Abstract 379 (1928)]. C. A. S.

2024. Attempted Detection of the Spontaneous Transformation of Helium into Penetrating Radiation. G. T. P. Tarrant and L. H. Gray. *Cambridge Phil. Soc., Proc.* 132. *pp.* 124–127, *Jan.*, 1932.—Experiments were made to test whether any penetrating radiation could be detected under laboratory conditions from a number of cylinders containing compressed helium. The ionisation method was used. Instead of the ionisation increasing when He was present a decrease was observed which is to be attributed to the absorption by the He containers of penetrating radiation and of the γ-radiation from the walls of the room. From the results of the observations there is found an upper limit for the decay constant of the hypothetical disintegration in which an atom of He is supposed to be completely transformed into a quantum of very penetrating radiation. This decay constant $\lambda < 5 \cdot 66 \times 10^{-27}$sec.$^{-1}$ and the half-value period $T > 3 \cdot 88 \times 10^{13}$ years. Atmospheric He cannot account for more than 2 % of the observed ionisation due to penetrating radiation. He in interstellar space, if it emits any penetrating radiation, can only account for the intensity of the hard component observed at the surface of the earth if it is present to a greater extent than 0·1 %. J. J. S.

HEAT.

2025. Quantum Mechanical Theory of Energy Exchanges between Inert Gas Atoms and a Solid Surface. J. M. Jackson. *Cambridge Phil. Soc., Proc.* 28. *pp.* 136–164, *Jan.*, 1932.—This paper arises from the work of Roberts [see Abstract 893 (1931)] who in the study of the interaction between gas atoms and solid surfaces took precautions in the preparation of the wall surface. Previously the walls must have been covered with at least a mono-molecular film of gas. Thus the values found for the accommodation coefficient were many times larger than those obtained by Roberts. In the present paper a quantum mechanical theory of the interaction of gas atoms and solid surfaces is developed. A one-dimensional problem is considered and not a general one. In this only the essential features are contained. A simple potential hill is considered in dealing with the potential field outside the surface of the solid, the interaction of the gas atoms with the potential hill being treated as a one-dimensional problem. J. J. S.

2026. Hugionot's Theorem Relating to the Flow of Liquids. E. Jouguet. *Comptes Rendus,* 194. *pp.* 141–146, *Jan.* 11, 1932.—Hugionot's theorem on the rôle of the speed of sound in the permanent flow of compressible fluids is set out in a more general way than usual and aims at insisting on its importance. The fundamental equations are first established for the flow of a fluid in a pipe whose section is a function of its length (l) and assuming (1) speed (v), temperature (T) and specific volume (σ) are constant, (2) friction against the walls is as given by Lorenz and Prandtl, dependent on the section, v, T and σ, and (3) the heat lost from the walls depends on l, v, T and σ. Thermodynamic relations are then applied and the critical points obtained, and the application of the relations to Hugionot's theorem and to a problem on the propagation of a deflagration given by Rankine follow. The nature of the critical points is discussed for certain conditions of cooling. [See following Abstract.] R. S. R.

2027. Cooled Diffusers. E. Jouguet. *Comptes Rendus,* 194. *pp.* 213–217, *Jan.* 15, 1932.—In the technique of tubes for compressible fluids divergence is replaced by the contraction caused by cooling. The function of this form of apparatus is considered by applying the equations and hypotheses given earlier [see preceding Abstract]. For simplification friction at the walls is neglected. Two cases are considered: (1) a cooled cylindrical diffuser, and (2) a cooled convergent cylindrical diffuser, and the conditions for various degrees of compression are discussed. The former is shown to be sensibly equivalent, as regards compression, to an adiabatic divergent diffuser, and it is less obstructed and less subject to irregular flow. It is thought that these considerations give correct qualitative indications of the rôle of the curvature of the profile of diffusers with regard to efficiency. R. S. R.

2028. Evaporation and Heat Transfer in a Laminar Gas Stream at Constant Velocity, with Application to the Assmann Psychrometer. A. Svensson. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 22*A*. 23. [28 *pp.*], 1932. *In German.*—Starting from the diffusion equation $\partial p/\partial t = k\partial^2 p/\partial x^2$, where p is the vapour pressure, t the time, x the space coordinate and k the diffusion constant, the humidity condition of air at time t and position x is calculated, when initially dry air passes in streamline flow over a plane moist surface. This leads to an expression for the rate of evaporation of moisture from the plate. A similar calculation gives the convection loss of heat, and the paper goes on to consider the simultaneous exchange of heat and of water vapour, leading to a theoretical evaluation of the constant A in Sprung's classical formula. This is compared with observation. The paper also deals with the effect of radiation on the indications of the wet-bulb thermometer. J. H. A.

2029. Apparatus for Measurements Down to 2° Absolute. K. Mendelssohn. *Zeits. f. Physik*, 73. 7–8. *pp.* 482–501, *Dec.* 30, 1931.—A method is given of passing from the temperature of liquid hydrogen to below the critical point of helium by utilising the heat of adsorption when carbon or other material is outgassed. The adsorbing material, preferably a suitable variety of carbon, is allowed to take up helium at liquid hydrogen temperatures, and the heat evolved in the process permitted to leak away. The adsorbent is then insulated thermally, and the gas removed by evacuating the container with a powerful pump, thus cooling the apparatus, as the heat of adsorption is withdrawn from it. The paper itself should be consulted for the constructional details, which are fully set out. [See following Abstract.] J. H. A.

2030. Specific Heat of Solid Hydrogen at Liquid Helium Temperatures. K. Mendelssohn, M. Ruhemann and F. Simon. *Zeits. f. phys. Chem.* 158. *Abt.B.* 2–3. *pp.* 121–126, *Dec.*, 1931.—The specific heat of solid hydrogen has been measured between 2·5 and 11·5° K. for the para-form and also for mixtures of ortho- and para-forms in the ratios 1 to 1 and 3 to 1. A calorimeter of the type developed by Nernst is employed, and the low temperatures are obtained by the "desorption" method [see preceding Abstract]. The curve for each variety passes through a minimum, which is lowest in the case of pure para-hydrogen. J. H. A.

2031. Partial Pressure Isotherms. Part I. W. D. Bancroft. Part II. S. C. Lee. *J. Phys. Chem.* 35. *pp.* 3160–3185, *Nov., and pp.* 3558–3582, *Dec.*, 1931.—The general conclusions of Part I are: Polymerisation, dissociation, heats of dilution, and solvation—except when a 1:1 compound is formed—are disturbing factors which increase the apparent molecular weight of one component, and decrease that of the other. A tendency to form two liquid layers increases the partial pressures and the apparent molecular weights of both components. Abnormally high molecular weights of both components have been observed for methyl, ethyl and propyl alcohol with water respectively, and for the same alcohols with benzene. A discussion of these cases is given. In benzene the order of apparent polymerisation is methyl alcohol > ethyl > propyl, whereas in water the order is reversed indicating not a characteristic of the alcohols but differing tendencies to form two liquid layers in the two solvents. It seems to be proved definitely that the true polymerisation coefficient of pure liquid water, of pure liquid methyl alcohol, and of pure liquid ethyl alcohol is distinctly less than two. In all the various systems studied, the effect of the tendency to form two liquid layers is negligible in very dilute solutions. On the other hand, it now appears as one of the most important factors in complicating the treatment of concentrated solutions. Criticism is included of the thermodynamic treatment of all disturbing factors under the single head of activity coefficients instead of trying to evaluate the single factors. In Part II a review of the theories and mathematical equations proposed in the above field indicates that most of them are based on assumptions that have insufficient experimental support. The binary systems benzene-methyl and benzene-propyl alcohol are studied, the partial pressures at 40° C. being determined by a modified form of the apparatus used by Sameshema. The above data, together with that from freezing-point experiments and heats of admixture, proved successfully the idea that the tendency to separate into two layers is one of the disturbing factors in such cases. The flat portions on the vapour pressure-concentration curves are due to the weak miscibility between the components—the greater the tendency to separate into layers, the more prominent will be the flatness in such curves. The vapour pressure-concentration curves of the system heptane-butyl alcohol have flat portions just like that of benzene-methyl alcohol, and, like the latter, the separation into two layers can easily be effected by sodium iodide. The Bancroft-Davis equation was applied to the data obtained with only partial success, which is probably due to the serious disturbances caused by the tendency to separate into two layers. H. H. Ho.

2032. General and Special Expression of Nernst's Heat Theorem. H. Schmolke. *Preuss. Akad. Wiss. Berlin, Ber.* 33. *pp.* 780–783, 1931. —Discusses the relation between Nernst's expression lim $dA/dt = 0$, when $T = 0$, and Planck's suggested method of formulating the theorem, *viz.*, that lim $S = 0$ at $T = 0$. In these expressions, A is the maximum work for an isothermal reversible process, S is the entropy and T the absolute temperature. The meaning of the theorem is also considered in the light of experimental measurements of crystalline and non-crystalline forms of the same substance at low temperature. J. H. A.

2033. Quantum Mechanics and the Calculation of Virial Coefficients. J. G. Kirkwood. *Phys. Zeits.* 33. *pp.* 39–43, *Jan.* 1, 1932.—The equation of state of a gas can be written in the virial form $pV/RT = 1 + B/V + \ldots$, where p is the pressure, V the molar volume, T the absolute temperature and R the gas constant. The calculation of the first virial coefficient (B) by classical mechanics omits factors that the principles of quantum mechanics bring into view, and J. C. Slater has formulated the problem anew; he obtains an expression for the probable distribution of the molecules in the probable distribution space, but the application of his method is highly complicated. The author in collaboration with F. G. Keyes has previously given an expression for B, in which he now makes a correction, and proceeds to develop his formula and then to apply it to helium at low temperatures, considering only gases so rarefied as to permit the neglect of configurations that include the simultaneous reciprocal action of more than two molecules. He uses the new equation to calculate the virial coefficients of helium from 15° to 350° Absolute, and compares the results both with figures calculated from the classical equation and with observed results. At the higher temperatures both sets of calculated results are in agreement and appreciably lower than the observed results; but at the low temperatures, when B is negative, while the numerical values from the old equation are much higher than the observed results, the new equation gives figures only slightly greater and in reasonably good agreement with experiment. T. B.

SOUND.

2034. Microphonic Action of the Cochlea. E. D. Adrian. *Phys. Soc., Discussion on Audition, June* 19, 1931, *pp.* 5–9; *Disc., pp.* 135–151.—Refers to and criticises the work of Wever and Bray upon changes of electrical potential produced in the auditory nerve of a cat by sound incident upon the cat's ear. The author sets out his reasons for considering that the electrical effects they observed were not due to electrical impulses in the nerve fibres, but are electrical effects produced in the cochlea and conducted along paths of least resistance, of which the nerves are a special case. The author concludes that electrical changes due to nerve impulses in the auditory nerve have not yet been observed, that the Wever and Bray effect is likely to swamp these changes, and that it is difficult to see any way of disentangling the two phenomena. J. E. R. C.

2035. Auditory Mechanisms. R. T. Beatty. *Phys. Soc., Discussion on Audition, June* 19, 1931, *pp.* 10–18; *Disc., pp.* 135–151.—The author summarises and discusses the results of recent investigations upon the evolution of the hearing mechanism, the localisation of pitch sensitivity and binaural hearing. J. E. R. C.

2036. High-Frequency Deafness. A. W. G. Ewing. *Phys. Soc., Discussion on Audition, June* 19, 1931, *pp.* 19–21; *Disc., pp.* 135–151.—Describes the methods of investigating deafness which are in use at Manchester University and summarises the results of experiments upon 350 deaf persons. The majority of hearing curves show a greater loss in the upper than in the lower frequencies. Children who have been high-frequency deaf from birth can be trained to talk only with difficulty, since they cannot hear the important upper partials. J. E. R. C.

2037. Perception of Intensity of Sound in Various States of Aural Sensitivity. F. Allen. *Phys. Soc., Discussion on Audition, June* 19, 1931, *pp.* 22–34; *Disc., pp.* 135–151.—An account of researches conducted in the author's laboratory in collaboration with several other workers. It describes firstly, a method of estimating the shortest interval between two notes which will allow them to be resolved and shows that the equation $D = k_1/\log N + C_1$ represents the results. (D = duration of the sounds when they are just resolved and N = the frequency of the note.) He also shows that $D = k\log P + C$ where P = the intensity of the sound. Secondly, the effect of powerful pure and complex tones upon the value of D is investigated and the results are exhibited in several graphs. The external tones increase the value of D in their own frequency region. By an extension of the method the author claims to have demonstrated the objective reality of difference tones. An explanation of the difficulty of hearing "trills" in the bass notes of all musical instruments is offered. Thirdly, an investigation is made of the relation between the just perceptible increment of sound and the intensity and a departure from Weber's law is found. Fourthly, the depression and enhancement of aural sensitivity which can be produced by external tones are investigated. A Bibliography is appended. J. E. R. C.

2038. Dynamical Theory of the Ear. E. G. Richardson. *Phys. Soc., Discussion on Audition, June* 18, 1931, *pp.* 35–38; *Disc., pp.* 135–151. —The author proposes an electrical network to represent the ear and shows that it is capable of representing its known properties. These properties are illustrated with an account of some experiments by various authors. J. E. R. C.

2039. Artificial Production of Speech Sounds. R. A. S. Paget. *Phys. Soc., Discussion on Audition, June* 19, 1931, *pp.* 39–43; *Disc., pp.* 135–151.—The author describes the production of speech sounds by the human mouth, throat and nose and discusses the methods available for producing these sounds artificially by mechanical and electrical resonators. The possibility of using musical instruments for the same purpose is indicated. J. E. R. C.

2040. Nature of the Vowels. E. W. Scripture. *Phys. Soc., Discussion on Audition, June* 19, 1931, *pp.* 44–52; *Disc., pp.* 135–151.—Describes a microphone and string galvanometer method of recording air vibrations and shows some records taken in this way. The author discusses the bearing of his results upon present-day views as to the production and audition of vowels and claims to have disproved the overtone theory of vowel production and also that there is no fundamental tone present in a vowel sound. J. E. R. C.

2041. Analysis of Noise and Musical Sounds. E. Meyer. *Phys. Soc., Discussion on Audition, June* 19, 1931, *pp.* 53–61; *Disc., pp.* 135–151. —Describes researches employing the Grützmacher method in which the intensity/frequency spectrum is recorded automatically. The tones emitted by the following musical instruments were examined: pianoforte, clavichord, triangle, castanets, side-drum and bass-drum. An investigation of gramophone needle scratch is described and it is shown that it consists of two parts, a h.f. range, 800–10,000 $\sim$, and a l.f. range, up to 300 $\sim$. The latter are not troublesome in practice. The paper concludes with a comparison of the Grützmacher method with the subjective method using a warble tone. J. E. R. C.

V. 19

2042. Acoustic Measuring Instruments. C. V. Drysdale. *Phys. Soc., Discussion on Audition, June* 19, 1931, *pp.* 62–78; *Disc., pp.* 135–151. —The author endeavours to indicate promising methods of improving present-day acoustic measuring instruments. A standard of sound intensity is proposed consisting of a steel sphere with a mozaic of quartz crystals on its surface which can be maintained in vibration by utilising their piezoelectric properties. A modification of Bragg's amplitude meter is proposed with which this standard might be calibrated. The theory of sound-detecting devices is discussed with special reference to the Rayleigh disc, radiation pressure measurements and the Webster phonometer. It is deduced that a radiation pressure measurement by means of a torsion pendulum arrangement is to be preferred to the Rayleigh disc method. A moving-coil receiver is proposed, which, in conjunction with a suitable electrical arrangement, would measure the mean acoustic power. A null method of measuring the intensity of a pure tone is suggested as a development of a method proposed by Gerlach. J. E. R. C.

2043. Absolute Measurement of Sound Amplitudes. E. N. da C. Andrade. *Phys. Soc., Discussion on Audition, June* 19, 1931, *pp.* 79–81; *Disc., pp.* 135–151.—Particles of tobacco smoke introduced into a sounding tube take up the motion of the air in the tube and the author shows that for frequencies up to 2,000 $\sim$, the amplitude of the oscillation they describe is very nearly equal to that of the air. By measuring the amplitudes at a series of antinodes in a tube open at one end, a close approximation to the amplitude of the air motion may be obtained, and by providing the end of the tube with a baffle board a source of sound of calculable intensity may be obtained. Amplitudes of 0·01 cm. may be measured in this way. The paper is illustrated with two plates. J. E. R. C.

2044. Measurement of Noise. A. H. Davis. *Phys. Soc., Discussion on Audition, June* 19, 1931, *pp.* 82–91; *Disc., pp.* 135–151.—A description of methods in use at the National Physical Laboratory and elsewhere for the measurement and analysis of noise. The author discusses Kingsbury's ear sensitivity curves and shows that for the purpose of giving a value to the intensity of a sound it is practicable to give the intensity of an equally loud pure note of frequency in the region of 800 ∼. The question of annoyance due to a noise is discussed and a consideration of the masking effect of a note leads to the conclusion that the masking effect is not a very useful method of assessing the loudness of a quiet sound. Measurements of aircraft noise by the Barkhausen method are described and this method is shown to give consistent results. A method of assessing noise intensity from the decay of a tuning-fork is described and typical results obtained by this method are given. J. E. R. C.

2045. Objective Measurement and Subjective Perception of Sound. F. Trendelenburg. *Phys. Soc., Discussion on Audition, June* 19, 1931, *pp.* 92–100; *Disc., pp.* 135–151.—The author enumerates the advantages of providing sound-measuring instruments with a distorting circuit designed to make the response curves approximate to that of the human ear. The amount of the distortion should vary with the intensity of the sound and a circuit suitable for this purpose is described. Oscillograph records obtained with such an arrangement are reproduced and compared with records obtained by using an amplifier with an undistorted response curve. The author discusses the utility and possibility of introducing another characteristic of the ear, *viz.*, non-linear response, and concludes that this would be premature at the present time and that experience shows it to be of minor importance. The paper concludes with a Bibliography. J. E. R. C.

2046. Measurement of the Threshold Sensitivity of the Ear. H. Waetzmann and H. Heisig. *Phys. Soc., Discussion on Audition, June* 19, 1931, *pp.* 101–103; *Disc., pp.* 135–151.—The authors criticise earlier measurements of the threshold sensitivity of the ear. The acoustical energy received by the ear is determined by comparing the damping of a tuned telephone in contact with a human ear with the value when in contact with an artificial ear. The damping is determined from the measured resonance curves. Measurements were also made with the ear placed in a uniform sound field. Results are tabulated and it is concluded that the measured threshold sensitivity agrees within limits of error with the measurements of E. Meyer, but are slightly higher than those of Fletcher and Wegel. J. E. R. C.

2047. Basis of Sound Localisation. H. Banister. *Phys. Soc., Discussion on Audition, June* 19, 1931, *pp.* 104–113; *Disc., pp.* 135–151.—When extra-auditory clues are eliminated in an experiment the mechanism then employed is not necessarily normal. Sound localisation is definitely a binaural effect. The ear cannot judge distance and altitude. The physical differences between sound waves which may serve for localisation are intensity, phase, time and volume. Note that here "volume" is a measure derived from the fact that low notes, probably due to their wavelength, produce a sensation of spaciousness. The ears cannot ordinarily detect phase difference and we must therefore look to time differences for an explanation of localisation effects. The author indicates the significance of Adrian's work in this connection. A theory, depending upon bone conduction and due to Myers and Wilson, is considered and abandoned. The author discusses his own theory of localisation effects which assumes that the time differences between the nerve impulses in the auditory nerve fibres are responsible, and in this way he claims to explain many experimental results. J. E. R. C.

2048. Localisation of Sound by Observations of Intensity. W. S. Tucker. *Phys. Soc., Discussion on Audition, June* 19, 1931, *pp.* 114–119; *Disc., pp.* 135–151.—The author discusses various methods of enhancing the ear's localising ability, with particular reference to the localisation of aircraft. Curves are plotted showing the sensitivity of the trumpet and of the Rayleigh double-disc method. The double-disc method suffers from having, in general, two maxima, but provided that the intensity of the sound is not more than 8 db above threshold intensity, the smaller maximum disappears. J. E. R. C.

2049. Time Theory of Sound Localisation. E. M. v. Hornbostel. *Phys. Soc., Discussion on Audition, June* 19, 1931, *pp.* 120–127; *Disc., pp.* 135–151.—Describes some experiments upon sound localisation by animals. Compares and discusses the time and intensity theories of localisation and decides that Banister's theory [see Abstract 2047 (1932)], is not sufficient. The author proposes the assumption that binaural central processes are interactions between the uniaurally stimulated cells, the excitations of which act upon one another somewhat as the currents in the insulated wire of a cable. J. E. R. C.

2050. General Conditions of Auditory Experiments. F. C. Bartlett. *Phys. Soc., Discussion on Audition, June* 19, 1931, *pp.* 128–134; *Disc., pp.* 135–151.—Discusses the technique and presentation of results of auditory experiments, particularly those upon sound localisation and perception steps. In laboratory experiments the ear is asked to perform alone tasks for which it normally derives assistance from the other senses and there is a consequent increase in the "scatter" of judgments. Experimental results should include an account of the number of experiments, the number of observers, and of the method of serial presentation adopted. The case of an observer giving a consistent run of judgments and then switching over to a different consistent run is discussed and an explanation offered. Experimenters need to pay much more attention to adaptation effects. Weber's experiments upon the correlation of physical intensities with perceptual reactions are discussed. Fechner's principle is also considered and the author considers that in view of the fact that this depends upon a number of illegitimate assumptions, it would be better to rely only upon Weber's formulation—which gives everything required by experimental sciences. The author considers that all attempts at constructing scales of annoyance have so far been unsuccessful. J. E. R. C.

2051. Optical Sound Recording. J. Eggert, A. Küster, R. Schmidt. *Zeits. f. techn. Physik,* 12. 12. *pp.* 639–644, 1931.—The various methods of sound recording on films are discussed, and are classified as the transverse method, the intensity method, and the light-relay method. The qualities required in the photographic materials for each method and the distortions and disturbing noises associated with each are indicated. E. E. F. d'A.

2052. Natural History of the Vibrato. C. E. Seashore. *Nat. Acad. Sci., Proc.*, 17. *pp.* 623–626, *Dec.*, 1931.—The vibrato was studied from phonophotographic records of music and speech, and from psychophysic measurements on the perception of vibrato produced synthetically by instruments. In the artistic vibrato, the oscillation in pitch is about a half-tone with singers, and about a quarter-tone with string instruments. The rate is 6 to 7 ∼ and the pitch change is usually synchronous with changes in intensity and timbre. The vibrato is present during 95 % of the phonated time with singers. It is found in the singing of Indians and negroes, and occasionally in children's voices. The perception of the vibrato as beautiful rests on being subject to certain specified illusions. G. E. A.

2053. Architectural Acoustics. P. R. Heyl. *Bureau of Standards, Circ. No.* 396. [8 *pp.*], 1931.—A short summary of some of the early work on the subject. W. H. Ge.

2054. Groupings and General Behaviour of Solid Particles under the Influence of Air Vibrations in Tubes. E. N. da C. Andrade. *Roy. Soc., Phil. Trans.* 32. *pp.* 413–445, *Jan.* 30, 1932.—The movements of dust particles in the air in a sounding tube are explained in terms of a general circulation of the air between node and antinode, and a vortex motion round every particle. The vigour of the general circulation gains on that of the vortex motion as the sound vibrations increase in intensity, as a consequence of which the nature of the dust figures obtained is controlled largely by the intensity of the sound. Koenig's theory of ridge formation is shown to be fundamentally unsound. The different types of dust figures obtained with different powders by previous workers, in particular Kundt, can all be obtained with one kind of dust by suitable adjustment of frequency and intensity. The forces between two particles in air, vibrating with an intensity such that they are surrounded by vortex systems of the type described, may be either attractive or repulsive, according to the distance of separation. Owing to the lateral attraction and the longitudinal equilibrium position, ridges are formed, which are maintained by the vortex systems at fixed distances apart. When the particles are not of uniform size, intermediate ridges tend to be formed of the lighter particles, which are swept by the air vortices to a position between the main ridges. With uniform spherical particles, made of wax, no intermediate ridges can be formed and the spacing is regular. An empirical formula is given, connecting the spacing of the ridges with the distance from the antinode. When the intensity is large, the general circulation carries the ridges towards the node in a manner described at length in the paper, the dust being deposited in a ridge to either side of the node. The complicated motions of individual particles are ordered and explained by considering the effect of the spin of the particle in conjunction with the vibration and other movements of the air. H. H. Ho.

ELECTRICITY AND MAGNETISM.

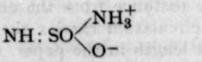
ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

2055. Effect of Mechanical Working on the State of a Solid Surface. R. F. Hanstock. *Phil. Mag.* 13. *pp.* 81–99, *Jan.*, 1932.—Phenomena occurring at the surface of a solid are likely to be affected by the production, by mechanical working, of surface layers with special physical properties. A brief survey of earlier researches on the effects of surface conditions on friction, contact potential and reflecting power is given. The author's investigations on tribo-electricity and photo-electricity are described in detail. Of several general conclusions the most important are the following:—A mechanically worked surface charges negatively when rubbed against a surface of the same material which is worked to a less degree. The charge produced when one surface is rubbed on another which is in such a condition as to be unchanged by the rubbing, is an exponential function of the number of rubs. The existence of a Volta contact effect between the interfaces insulator/insulator and metal/insulator seems to be established. The photoelectric current from a metal surface increases, at first, proportionately to the mechanical working but later becomes constant. These effects, produced by mechanical working, can be made to disappear by heating to a certain " relaxation " temperature which is roughly that at which plastic flow commences. N. D.

2056. Dielectric Constants of Solutions of Sulphamide in Water. G. Devoto. *Accad. Lincei, Atti*, 14. *pp.* 432–434, *Nov.* 15, 1931.—The results of the measurement of the dielectric constants of the sulphamide $SO_2(NH_2)_2$ when dissolved in water are given for different concentrations. The values are reduced to 25° C. Denoting the dielectric constant by ϵ, the concentration by c, and the dielectric coefficient by $d\epsilon/dc$ the following are the values found, the dielectric constant for water at 25° C. being taken as 77·85:

c.	ϵ.	$d\epsilon/dc$.
0·000	77·85	+ 7·0
0·097	78·52	
0·145	78·87	
0·181	79·10	

From this is deduced the probable polar formula of the compound:



$$NH : SO\begin{cases} NH_3^+ \\ O^- \end{cases}$$

J. J. S.

2057. Rapid Determination of Water by Measuring the Dielectric Constant. F. Garelli and G. Racciu. *Accad. Sci. Torino, Atti*, 66. 9–13. *pp.* 338–344, 1930–1931.—The method described, due to Berliner and Rüter (*Kolloid Zeits.* 47. p. 251, 1929), is based on the marked variation in the dielectric constant of materials such as sugar, cellulose, casein, rubber, starch, wood, paper, etc., with their moisture content. Most solid organic substances have dielectric constants varying between 1 and 10, whereas that of water exceeds 80. The method used for determining the dielectric constant consists in generating electric oscillations in a circuit consisting of an auto-induction coil and the capacity to be examined and in measuring the frequency, wave-length or some other magnitude (of the circuit itself or in a coupled oscillating circuit) related to the water content of the substance between the armatures of the condenser. From the reading thus obtained, the water content is read off on a curve relating to the particular material examined. Tests with wheat, barley, rye and flour give results agreeing satisfactorily with those of actual drying experiments, which often occupy many hours. T. H. P.

2058. Dispersion Measurements in Liquids, Especially Biological Solutions, with Undamped Waves of 1 to 4 Metres Wave-Length. E. May and H. Schaefer. *Zeits. f. Physik,* 73. 7–8. *pp.* 452–459, *Dec.* 30, 1931.—An apparatus is described for the measurement of the dielectric constants of liquids by means of undamped vibrations of continuously variable wave-length. A limit of accuracy of 5 % is attained with a specific resistance of 200 ohms/cm. of the liquid. Measurements of the dielectric constants of some biological substances show that within this limit of error the dielectric constant is independent of the wave-length. J. E. K.

2059. Structure and Electrical Properties of Insulating Materials. J. W. Williams. *J. Phys. Chem.* 36. *pp.* 437–443, *Jan.,* 1932. —This paper is a general review of recent work on the subject and discusses: the conduction of the electric current in dielectrics; the constitution and mode of formation of substances of high molecular or aggregate weight, the explanation of the macromolecular theory being favoured; physical studies on cellulose, silk, tissue and stretch rubber, which indicate the presence of long primary-valence-chain macromolecules; the nature of the secondary valence forces in the substances of high molecular weight; dependence of electrical properties on capillary structure; and finally the relation between the heat of liberation of a gm.-ion and the natural quantum of the lattice. Although the electrical behaviour of a crystal appears to be quite different from that of the type of substance described as a moisture-absorbing dielectric, many authorities believe the mechanisms in the two cases to be quite similar. H. H. Ho.

2060. Dielectric Constants of Phosphorus Trichloride and Pentachloride. T. M. Lowry and J. Hofton. *Chem. Soc. J. pp.* 207–211, *Jan.,* 1932.—In a previous paper Lowry and Jessop [see Abstract 3198 (1930)] found that sulphur tetrachloride exhibits the anomaly of having a higher dielectric constant in the solid state than when fused, and this indicated the occurrence of a change of molecular structure on fusion. It is now found that the dielectric constant of phosphorus trichloride falls from 3·498 at 17° to 3·139 at 59·8°, and that of phosphorus pentachloride increases from 2·85 in the liquid at 160° to 4·23 in the solid at 22·8°. This increase is attributed to a change of molecular structure on crystallisation. H. H. Ho.

2061. Dielectric Constant and Dipole Moment of Iron Pentacarbonyl. W. Graffunder and E. Heymann. *Zeits. f. phys. Chem.* 15. *Abt.B.* 4–5. *pp.* 377–382, *Jan.,* 1932.—The dipole moment of iron

pentacarbonyl, $Fe(CO)_5$, has been determined by the Debye method of dilute solutions, using a suspension apparatus, and found to be $\mu = 0{\cdot}81 \times 10^{-18}$ e.s.u. The molecular structure is discussed and, since a symmetrical arrangement around the iron atom would lead to a zero value for the dipole moment, the above result indicates that at least one CO-group has a special position, *e.g.*, at the apex of a four-sided pyramid; this assumption is in agreement with the chemical behaviour of iron carbonyl in which one CO-group is readily substituted by two chlorine atoms.
H. H. Ho.

2062. Dielectric Polarisation of Hydrogen Chloride in Solution. Part I. Benzene, Cyclohexane and Carbon Tetrachloride. F. Fairbrother. *Chem. Soc., J. pp.* 43–55, *Jan.*, 1932.—Full experimental details are included of measurements of the dielectric constants, refractive indices, densities and compositions of solutions of HCl in benzene, cyclohexane and carbon tetrachloride. The results show that the polarisation of hydrogen chloride even in these non-polar solvents is greater than that in the gaseous state. This is supported by the fact that a calculation of the dielectric constants of such solutions, as carried out by Bell [see Abstract 3545 (1931)] for saturated solutions, presumably on the assumption of a polarisation similar to that in the gaseous state, leads to values which are below those actually found.
H. H. Ho.

2063. Dipole Moments of Molecules with Independent Dipole Groups. L. Ebert and K. Højendahl. *Zeits. f. phys. Chem.* 15. *Abt.B.* 1. *pp.* 74–78, *Dec.*, 1931.—In a previous theoretical publication the dipole moment of a molecule with two independent dipole groups, *e.g.*, at both ends of a very long aliphatic chain, has the value $\sqrt{2}\cdot\mu$, where μ is the group moment of the single polar group. This expression has now been substantiated by a number of recently published experimental results, *e.g.*, those of Smyth and his co-workers on ethyl esters of acids of the fatty and oxalic acid series, and on glycols; and of Waldschmidt on the diketone tricosan-8, 16-dion, $CH_3{-}(CH_2)_6{-}CO{-}(CH_2)_7{-}CO{-}(CH_2)_6{-}CH_3$, where the moment is $3{\cdot}6 \times 10^{-18}$, *i.e.*, approximately $\sqrt{2} \times 2{\cdot}7 \times 10^{-18}$, which is the ketone-group moment.
H. H. Ho.

2064. Electric Moment and Molecular Structure. Part VI. Variation of Electric Moment with Temperature. C. P. Smyth, R. W. Dornte and E. B. Wilson, Jr. *Am. Chem. Soc., J.* 53. *pp.* 4242–4260, *Dec.*, 1931. The question of the variation of the electric moment of a molecule with temperature has been discussed and the energy of a system of dipoles rotating about a common axis has been calculated in terms of both classical and wave mechanics; the conclusion is drawn that the moment of a molecule containing such a system may vary with temperature. The electric moments of ethylene chloride and chlorobromide, which contain such systems of dipoles, are found to vary markedly with temperature. The electric moment of the ethyl acetate molecule shows no significant variation with temperature, probably because of the high mutual potential energy of its dipoles. The moment of the diethyl succinate molecule increases from 0° to 180° C., probably because increasing vibrational energy enables more and more of the molecules to open out to an extended structure in which the $-\ COOC_2H_5$ groups are independent of one another, the moment at 180° being identical with those of the very long chain dicarboxylic acid esters. As three of the above and also ethylene bromide show moments in heptane different from those in benzene, the moment of a molecule containing two or more dipoles, the axes of which may alter their positions relative to one another, may be affected by both temperature and environment. [For Part V see Abstract 182 (1932).] H. H. Ho.

2065. Systematic Errors in Measurements of Ionic Content and the Conductivity of the Air. O. H. Gish. *Gerlands Beitr. z. Geophys.* 35. 1. *pp.* 1–5, 1932. *In English.*—It is pointed out that the possible sources of error in ionic content and air-conductivity measurements made with the charging-method, which were discussed in recent papers by Y. Itiwara and by J. Scholz [see Abstracts 1993 and 2768 (1931)], were recognised when this method was adopted in the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, and that suitable provisions were made to obviate such errors. The design of ion-counter which embodies these provisions is described in detail. The effect of large ions upon the ionic-content measurements, and of distortions of the earth's electric field in the region from which air is drawn for both ionic-content and air-conductivity measurements, is discussed and it is concluded that these sources of error are negligible for the conditions prevailing on the *Carnegie* at sea. AUTHOR.

2066. Angular Distribution of Cosmic Rays. D. Skobelzyn. *Comptes Rendus,* 194. *pp.* 118–121, *Jan.* 4, 1932.—From new experiments the distribution of cosmic rays within different angular zones is established. It appears that the numbers of particles observed under different angles are sensibly distributed according to the cosine law. It results that the intensity of the ultra-rays under the conditions of the experiment is almost independent of the zenith distance of the direction chosen. The observations made lead to the following hypothesis: The courses observed are due to the secondary rays of a radiation either electromagnetic or corpuscular, of which the directions are more or less independent of the direction of the primary ray. It does not seem possible to look at this result on the basis of known mechanisms of absorption of corpuscular or electromagnetic rays of the ordinary type. J. J. S.

2067. Theory of the Polar Aurora. A. Dauvillier. *Comptes Rendus,* 194. *pp.* 192–194, *Jan.* 11, 1932.—Auroral observations were made during the period of winter darkness at Sodankylä (Finnish Lapland) and confirmed the theoretical conclusions given earlier [see Abstract 187 (1932)] regarding various geophysical phenomena. The aurora is considered to be a secondary effect of cosmic phenomena initially very distant from the earth. The first phase corresponds to the initial cosmic effect and is of brief duration while the second phase is a slow phosphorescence due to excitation, ionisation and polymerisation (O_3) produced by the secondary electrons. The production of high-speed auroral clouds and fugitive and isolated rays is discussed. Photometric estimates lead to 15×10^3 kW as the energy of an auroral storm. Potential gradient measurements show a minimum of 55 volts/m. at 4 h. and a maximum of 138 volts/m. at 17 h. G.M.T., the field being halved by the proximity of the aurora as theory dictates. The intensity of the cosmic rays was measured at a depth of 1·5 m. below water and ice and it shows fluctuations of 2·5 % (error is ± 0·5 %) and they are not attributable to atmospheric pressure variations or magnetic activity. R. S. R.

2068. Distribution of Magnetic Declination within the Arctic Zone. B. P. Weinberg. *Terr. Mag.* 36. *pp.* 273–278, *Dec.*, 1931.—A method of successive approximations employed by the author in the U.S.S.R. and adjacent countries has been used for the element, e, and its secular variation (annual change), e', to obtain $de/d\phi$, $de/d\lambda$, $de'/d\phi$ and $de'/d\lambda$ where ϕ and λ are latitude and longitude respectively. Values of the second approximation distribution of the annual change of declination and first approximation distribution of the declination are obtained. The results are summarised in figures showing (1) theoretical isopors (lines of equal annual change) within 100 km. of the magnetic pole due to its motion, and (2) mean isopors of magnetic declination in the Arctic regions for the period 1890–1930, and a table giving the magnetic declination and its annual change in the Arctic at the approximate epoch 1930.
R. S. R.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

2069. Measurement of Conductivity without Electrodes. W. Braunbek. *Zeits. f. Physik*, 73. 5–6. *pp.* 312–334, *Dec.* 10, 1931.—A description is given of an electrodeless method for the relative measurement of the electric conductivity of metals and alloys, especially in the liquid state. The method depends on the measurement of the turning moment which the test body experiences in consequence of induced vortex currents in a magnetic rotating field. The applicability of the method is illustrated by two examples, *viz.*, copper and mercury at 400° C. The method permits of observations within limits of error of less than 0·5 %.
J. J. S.

2070. Change in Electrical Conductivity of Fused Bismuth Containing Dissolved Bismuth Chloride. W. Braunbek. *Zeits. f. Physik*, 73. 5–6. *pp.* 335–347, *Dec.* 10, 1931.—The conductivities of the solutions were measured by a rotating-field method, without electrodes. The crucible was suspended by a thin metal strip, and the torque was measured. The diminution of the conductivity due to the added chlorine is remarkably small, being only of the same order of magnitude as that produced by a foreign metal. With dilute solutions of BiCl in fused Bi 1 % (atomic) of Cl lowers the conductivity by about 3 %; with 7·5 % (atomic) of Cl the conductivity is still more than half of the value for pure Bi.
H. N. A.

2071. Electrical Conductivity Method of Determining the Effective Capillary Dimensions of Wood. A. J. Stamm. *J. Phys. Chem.* 36. *pp.* 312–325, *Jan.*, 1932.—The ratio of the effective capillary length, l, to the effective capillary cross section, q, of wood fibres may be determined by comparative measurements of the electrical conductivity of a salt solution which completely fills the voids of the wood and that of the same salt solution in bulk. Surface effects are negligible if the concentration of the solution used exceeds 0·07 M., and if this condition is observed the results are independent of the concentration. Measurements with a variety of woods show that for a single species the ratio l/q varies directly with the density of the specimen, and has practically the same value for the sapwood and the heart-wood. The average radii of the capillaries have been calculated from the results in conjunction with data obtained from measurements of hydrostatic flow; these values of the average radii are compared with those of the maximum effective radii derived from determinations of the pressure necessary to overcome the effect of surface tension. The maximum values are from 1 to 6 times the average, and approach the average more nearly when the conditions of the measurements are such that a large number of pit membranes are traversed in series. The effective radii of pit membrane pores are greater for sapwood than for heartwood, but the difference varies with the species. H. F. G.

2072. Voltage Effect in Electrolytic Solutions with the Kathode Ray Oscillograph. W. Fucks. *Ann. d. Physik*, 12. 3. *pp.* 306–318, *Jan.* 8, 1932.—Describes a method by which changes of resistance which take place during a momentary application of voltage can be measured with the kathode-ray oscillograph. The oscillographs show clearly the conductivity effect discovered by Wien. The relation of the effect to the field intensity, its relation to the ionic valency and to the concentration of the electrolyte are recorded. Comparison with Wien's measurement shows a complete qualitative agreement and, within the limits of accuracy of the oscillograph method, quantitative agreement. H. N. A.

2073. Absorption of Dipole Liquids and of Electrolytes in the Region of Short Electric Waves. J. Malsch. *Phys. Zeits.* 33. *pp.* 19–21, *Jan.* 1, 1932.—The absorption measurements have been made for alcohols and alcoholic solutions, concise experimental details being given. Data are included for methyl, ethyl, *n*-propyl and *n*-butyl alcohols for which a simple relationship for electrical dispersion and absorption appears to be indicated. This method of the direct measurement of absorption may also be employed for the absolute determination of the h.f. conductivity of electrolytes. H. H. Ho.

2074. Theory of Non-Volatile Insulating Atomic Lattices. F. Hund. *Zeits. f. Physik*, 74. 1–2. *pp.* 1–17, *Jan.* 22, 1932.—The author reviews the behaviour of volatile atomic or molecular lattices, which are insulators, of ionic lattices, which are also insulators, and of metallic lattices, which are conductors; and briefly shows the positions they take in his theory. The main theoretical investigation is devoted to the non-volatile insulating atomic lattices, and particularly to the diamond. The fact that the diamond is an insulator implies that out of the swarm of terms which correspond to the ground state of a number of separate atoms, one exists in the crystals as ground term, separate from the others, and at a finite distance below them. In a metallic conductor, on the other hand, the ground state belongs to a continuance of closely neighbouring states; the problem is worked out, first on the basis of the analogy of a one-dimensional chain of atoms. It is shown that a necessary condition for a non-volatile insulator is $n = r = t$, where n is the number of valence electrons per atom, r the number of direct neighbours for each atom and t the number of available electronic eigenfunctions per atom. H. N. A.

2075. Unpolarised Resistivity of Glass. D. M. Robinson. *Physics*, 2. *pp.* 52–59, *Jan.*, 1932.—An experimental comparison has been made of three methods of measuring the unpolarised resistivity of glass and fused quartz over a temperature range from 20° to 500° C. At high temperatures all three methods are in quantitative agreement and give a straight line when the logarithm of the resistivity is plotted against the reciprocal of the absolute temperature. At lower temperatures, however, the a.c. curve deviates from this straight line, indicating an additional component of loss which does not exist on d.c. This additional loss may be due to the orientation of polar molecules, though no definite proof can be given. The results obtained by the other two methods, both with d.c., are in close agreement over the whole temperature range, and give without doubt the true unpolarised resistivity. AUTHOR.

2076. Law of Electrical Resistance for Low Temperatures. R. Peierls. *Ann. d. Physik,* 12. 2. *pp.* 154–168, *Jan.* 2, 1932.—The author previously criticised the result of Bloch in which the proportionality of the electric resistance of an ideal metal at low temperatures to T^5 was indicated. He concluded that a T^4 law should be substituted [see Abstract 2262 (1930)]. He now finds that an approximation which led to the supposed T^4 rule is not allowable, and a correct method leads to Bloch's result for dependence on temperature and order of magnitude which show that a T^5 law holds. J. J. S.

2077. Electric Sparks. Part II. T. Kobayasi. *Phys. Math. Soc., Japan, Proc.* 13. *pp.* 310–316, *Dec.,* 1931. *In English.*—The surface of a glass or ebonite plate was charged from an influence machine and an earthed conductor brought near to it. The sparks thus produced were investigated. The appearance of the spark under these conditions differed very much according to the sign of the surface charge. When the charge was positive, the path forked into many branches and each branch curved smoothly. When the charge was negative, the discharge took place in two stages and the bright paths had zigzag forms. Typical examples are reproduced. In cases where a voltage below the sparking potential was applied to a pair of electrodes, bringing an insulator plate with a large surface charge in contact with the electrodes caused a spark to pass. The results are briefly discussed. [See also Abstract 943 (1931).] A. W.

2078. Mechanism of the Electric Arc. W. Ramberg. *Ann. d. Physik,* 12. 3. *pp.* 319–352, *Jan.* 8, 1932.—A review of previous work on the electric arc leads to the conclusion that in the case of arcs between metals, such as copper or mercury, the thermal arc theory cannot be valid. Substances can be divided into two groups according to their electron emission at boiling point: (*a*) copper and those which behave like copper (Hg, Au, Ag) and (*b*) carbon and those which behave like carbon (probably W and perhaps also Ca, Mg). The substances in one group behave in a similar manner and differ from those of the other group. The copper group show a high mobility of the kathode spot and in consequence a rotating arc is easily maintained; a.c. arcs can only be maintained with difficulty, but the metals of this group are particularly suitable for use in quenched spark gaps. The materials of the carbon group have quite different properties, the kathode spot has a very low mobility, so that rotating arcs cannot be maintained; a.c. arcs can, however, be maintained even in nitrogen, but the materials of this group are not suitable for use in quenched spark gaps. Between these two main groups there are a number of metals, such as brass, Fe, Al, Zn, Ni and Pb, whose properties lie between those of the two extreme groups. The difference in the behaviour of the copper and carbon groups cannot be explained by differences in heat conductivity. A. W.

2079. H.F. Electric Discharge. C. Gutton and G. Beauvais. *Comptes Rendus,* 194. *pp.* 338–341, *Jan.* 25, 1932.—It has been shown by

Gutton [see Abstract 2258 (1930)] for low pressures and by Gill and Donaldson [see Abstract 563 (1932)] for higher pressures that for h.f. discharges very slight changes of pressure may cause sudden jumps in the value of the p.d. at which the discharge starts or stops, these effects being found at pressures which depend on the frequency of the oscillations and the distance of the electrodes. In the present paper are given the results of an investigation of the way in which the extinction p.d. varies with the distance between the electrodes. The frequencies used correspond to wave-lengths between 22 and 5·25 m. The results are given in a series of curves, which are briefly discussed. A. W.

2080. Study of a Neon Discharge by Use of Collectors. C. G. Found and I. Langmuir. *Phys. Rev.* 39. *pp.* 237–253, *Jan.* 15, 1932.—Experiments are described from which it is concluded that electrons are emitted from a negatively charged collector in the positive column of a neon discharge. The influences of conditions in the plasma and conditions in the sheath are separated and their influence on the formation of a cold-kathode discharge considered. Measurements of currents to a negatively charged collector in un-ionised neon beyond the end of the positive column, with variation of position of the collector, discharge current and external conditions, support the theory that resonance radiation travels in straight lines over large distances beyond the end of the positive column. The absorption of this radiation and collisions of the second kind result in the formation of metastable atoms, which diffuse into contact with the walls or with metallic electrodes and there liberate electrons. AUTHORS.

2081. Development of Electric Discharge as Affected by the Residual Charge. S. Mochizuki. *Phys. Math. Soc., Japan, Proc.* 14. *pp.* 13–21, *Jan.*, 1932.—The characteristics of the spark discharge are studied with special reference to the action of the residual charge distributed along the traces of the brush discharge, for (1) a portion of a resonant wave, and (2) uni-directional pulsating wave. The results can be summarized as follows: (1) The sparkover distance increases gradually as the frequency increases from 50 $\sim$ to about $3 \times 10^6 \sim$, beyond which it decreases rapidly and approaches the value for the case of a single impulse with its tail chopped off by means of a sphere gap of the same length. (2) The positive Lichtenberg figure produced by a uni-directional pulsating potential with two voltage peaks shows that the discharge spreads radially to the extent corresponding to the first voltage peak; but the subsequent discharge due to the next voltage peak takes place, spreading along the traces of the previous shoot for some distance, and then proceeding just between the streaks of the former discharge. (3) In the case of a uni-directional pulsating wave, the positive sparkover distance is always longer than that for a single impulse; for the negative discharge, however, it is reversed. The above results are discussed from the consideration of the phenomena such as the mobility of ions, their diffusion and the variation of potential gradient by the space charge. AUTHOR.

2082. Active Nitrogen. Part IX. Electrical Conductivity of Active Nitrogen. E. J. B. Willey and W. A. Stringfellow. Part X. Supposedly Oxidisable Variety of Nitrogen. E. J. B. Willey and S. G. Foord. *Chem. Soc., J. pp.* 142–161, *Jan.*, 1932.—Part IX.—The removal of charged particles from active nitrogen does not affect its reaction with nitric oxide or presumably its general chemical reactivity.

The results of Constantinides are confirmed [see Abstract 3176 (1927)], showing that the conductivity of active nitrogen is most probably due to emission of electrons from the testing electrodes. The emission is not photoelectric in character, but is due to actual impact of the active nitrogen upon the electrodes. The conductivity appears to be due to ejection of electrons from the metal testing electrodes by deactivation of 8-volt metastable molecules incident thereupon [see Abstract 3419 (1930)]. Part X.—A search has been made for a modification of nitrogen, or an unstable nitrogen oxide, which can react with ozone to give nitrogen peroxide, and whose existence was postulated by Lowry [see Abstract 1887 (1913)]. No evidence supporting, but much evidence against, the existence of such a substance is obtained, and it is furthermore shown that Lowry's results may be interpreted on the basis of known reactions of the nitrogen oxides and ozone. T. H. P.

2083. Mean Free Path and Excitation Function of Sodium Vapour. L. S. Ornstein and B. Baars. *K. Akad. Amsterdam, Proc.* 34. 9. *pp.* 1259–1263, 1931. *In German.*—The sodium vapour was excited by electrons in a special form of tube heated by an electric oven. The yellow line was compared with the mercury green line, and from intensity considerations the mean free path, chance of excitation and excitation-function are deduced. F. S.

2084. Elastic Collisions between Slow Electrons and Atoms. J. S. Townsend. *Roy. Soc., Proc.* 134. *pp.* 352–356, *Nov.* 3, 1931.—In connection with the paper by Bullard and Massey [see Abstract 2784 (1931)], the author quotes various references to prove that it is unjustifiable to refer to the variation of the effective cross-section of atoms with the velocity of electrons that collide with them as the "Ramsauer effect," since many results first obtained in the Electrical Laboratory, Oxford, were only subsequently obtained by Ramsauer and his collaborators when the Ramsauer method had been considerably refined. H. L. B.

2085. Collision of Electrons with Rotating Dipoles. H. S. W. Massey. *Cambridge Phil. Soc., Proc.* 28. *pp.* 99–105, *Jan.*, 1932.—Calculations concerning the collisions of electrons with molecules are, in general, very difficult, but when the molecule is an axially symmetric dipole Born's method may be applied, whatever the velocity of the electrons. It is shown how to calculate the excitation probability when the molecule is initially in the ground state, and that the probability of exciting the first rotational state is much greater than that of an elastic collision. Collisions when the molecule is not initially in the ground state are discussed, and it is shown that an electron beam passing through a gas consisting of weak dipolar molecules will rapidly become diffuse and inhomogeneous. A numerical example is worked out. N. D.

2086. Full Differential Secondary Radiation in Air for Electrons of Medium Velocity. E. Kipphan. *Ann. d. Physik*, 12. 4. *pp.* 401–432, *Jan.* 21, 1932.—A beam of electrons of medium velocity enters a large vessel containing air, and in passing through a plane layer bounded by two parallel gauzes, produces full differential secondary radiation, which is measured. The amount produced increases with the gas pressure, at first linearly, then more rapidly. Methods of removing various sources of error are discussed. The distribution of intensity over the cross-section of the beam is measured by two methods and used to show that diffusion has little effect on the amount of secondary radiation. When the primary beam meets the gas molecules, most electrons are slightly deviated and form a diffuse beam, which can be detected photographically. Others are deviated through large angles, though seldom more than 90°. These can only be detected indirectly. Energy relations of primary and secondary electrons are discussed. N. D.

2087. Application of Laws of Similarity to Streaming of Electricity in Gases. H. Mache. *Phys. Zeits.* 33. *pp.* 43–46, *Jan.* 1, 1932.—It is shown that the laws of similarity given by Reynolds for hydrodynamics may with advantage be utilised for the case of streaming of electricity in ionised gases. A. W.

2088. Dissociation of Nitrogen and Carbon Monoxide by Electron Impact. J. T. Tate and W. W. Lozier. *Phys. Rev.* 39. *pp.* 254–269, *Jan.* 15, 1932.—The energies of the dissociation products of N_2 and CO formed by electron impact have been studied. The kinetic energy distributions of C^+ ions from CO and N^+ ions from N_2 have been measured and for both gases the most probable kinetic energy of the ions is about 3 volts. The variation with electron energy of the probability of production of N^+ ions from N_2 and C^+ ions from CO (the ions having specified energies) has been studied. The minimum electron energies necessary to produce C^+ and N^+ ions of specified energy have been determined and they satisfy the requirements of the principle of conservation of energy. From these measurements heats of dissociation as follows have been determined: $N_2 \rightarrow N + N$, $8{\cdot}4 \pm 0{\cdot}5$; $N_2^+ \rightarrow N^+ + N$, $\geq 7{\cdot}1 \pm 0{\cdot}5$; $CO \rightarrow C + O$, $9{\cdot}3 \pm 0{\cdot}5$; $CO^+ \rightarrow C^+ + O$, $\geq 6{\cdot}4 \pm 0{\cdot}5$. The following are probably the dissociation processes detected in the experiments:

Process.	Energy of Ions (volts).	Energy of Impacting Electron (volts).
$N_2 \rightarrow N^+ + N + e$	2 to 7	27 to 37
$N_2 \rightarrow N^+ + N^* + e$	1 to 2	35 to 37
$N_2 \rightarrow N^+ + N^+ + 2e$	4 to 8	46 to 54

Negative ions (O^-) were observed and are believed to result from the following processes:

Process.	Energy of O^- Ions (volts).	Energy of Impacting Electron (volts).
$CO + e \rightarrow C + O^-$	0 to 1	10 to 14
$CO \rightarrow C^+ + O^-$	0 to 2	22 to 26

AUTHORS.

2089. Ionised Gases in a Magnetic Field. Proof of the Existence of the Rotating Electron. T. V. Ionescu and C. Mihul. *Comptes Rendus*, 194. *pp.* 70–72, *Jan.* 4, 1932.—Extends the work of previous papers [see Abstract 2411 (1931)]. The effect of a magnetic field on the conductivity of a gas forming the dielectric of a condenser is investigated for h.f. oscillations. The conductivity is due to free electrons and to electrons attached to molecules. The effect of the field on each part is obtained and exhibited by curves. It is deduced that the attached electrons reside in a molecular magnetic field of strength 10·5 gauss. Theoretical relations connecting conductivity and field are deduced, giving curves which agree well with those derived from experiment. N. D.

2090. Efficiencies of Ionisation and Ionisation Potentials of Various Gases Under Electron Impact. J. T. Tate and P. T. Smith. *Phys. Rev.* 39. *pp.* 270–277, *Jan.* 15, 1932.—The efficiencies of ionisation of N_2, CO, O_2, NO, H_2 and C_2H_2 by electron impact have been measured. The curves are similar to those of He, Ne, A and Hg vapour. The ionisation potentials of the molecules were found to be: N_2, 15·7; CO, 14·1; O_2, 12·5 and 16·1; NO, 9·5; H_2, 15·6; and C_2H_2, 11·6. The probable error in each case is about a tenth of a volt. Negative ions were formed by electron impact in NO, CO, O_2 and C_2H_2. None were observed in H_2 or N_2. AUTHORS.

2091. Comparisons of Positive and Negative Ions Produced by Slow Electron Impact in Mercury Vapour. Y. Takamura. *Phys. Math. Soc., Japan, Proc.* 13. *pp.* 321–328, *Dec.*, 1931. *In English.*—The relative quantities of positive and negative electricity due to ionisation by impact of slow electrons in mercury vapour were measured in six different cases. In the case of positive ions the ionisation current reaching a collecting electrode showed a saturation effect for an excess voltage on the collecting electrode of about 2 volts. In the case of negative ions this effect was not observed in the low range of voltage of the collecting electrode, the current in this range showing a linear increase with the voltage. Observations of the saturation voltage were rendered very difficult in this case by the effect of the primary electron current. The ionisation potential as determined for the positive and for the negative ions was found to be the same. At higher voltages both curves have a maximum at about 50 volts, but the magnitude of the negative current was only about one-tenth that of the positive current. A. W.

2092. Production of Positive Ions of High Velocity by Multiple Accelerations. J. Thibaud. *Comptes Rendus,* 194. *pp.* 360–362, *Jan.* 25, 1932.—Positive ions from a discharge tube with cooled anode and kathode are shot through a capillary 12 cm. long and then through a series of tubes connected alternatively to the ends of a coil, coupled to the oscillatory circuit of a triode of 800 watts. The lengths of the tubes should increase in proportion to the velocity previously acquired by the ions. By this means the speed of the ions is progressively increased, the final velocity being measured by deflecting the beam in a powerful magnetic field and receiving it on an electrode placed eccentrically and connected to a sensitive galvanometer. In spite of the low power of the triode used, ions of velocity corresponding to 145 kV have been obtained using Hg^+ ions, an oscillating potential of 13 kV and 11 accelerating tubes. The wave-length employed was in this case about 100 m. Using damped waves of wave-length 100 m. an accelerating potential of 39 kV was obtained, but the damping prevented synchronisation being effected. In order to obtain kinetic energies comparable with that of α-rays the number of accelerating tubes would have to be much increased, the length of the accelerating system being then about 12 m. In addition the power of the oscillator would have to be considerably augmented, reaching perhaps 100 kW. A. W.

2093. Registration of Kathode Rays by Thin Films of Metals and Metal Compounds. W. W. Nicholas and C. G. Malmberg. *Bureau of Standards, J. of Research,* 8. *pp.* 61–65, *Jan.,* 1932.—A search was made for a method of registering kathode rays analogous to the photographic method which could be carried out entirely in daylight and in which no development process would be required. For this purpose thin metal films (Pb, Ag, Bi, Sn, Cd, As, Cu, Sb, Zn, Mg, Se) were deposited on glass by evaporation from a coiled tungsten filament in a vacuum. These were then exposed, in vacuum, to a beam of 10 kV kathode rays. Films of Pb and Sn so thin as to be quite transparent before exposure were darkened to a density of the order of 0·5 by exposure to 0·01 coulomb/cm.^{2}. Also opaque films of the above metals were exposed to the vapours of various acids (HCl, HNO_3, HBr, HI, H_2S, H_2SO_4); this generally produced a lowered opacity, in many cases the films becoming quite transparent. Exposure to kathode rays tended to restore the original opacity. In general, the best effects were obtained with nitrates and bromides; $Bi(NO_3)_3$ seemed to show the most promise as to sensitivity and permanence of the record. The kathode-ray bombardment caused practically all the films to fluoresce, the colour and intensity of the fluorescence depending on the material. AUTHORS.

2094. Determination of Inner Potentials of Crystals by Kathode-Ray Reflection. T. Yamaguti. *Phys. Math. Soc. Japan, Proc.* 14. *pp.* 1–6, *Jan.,* 1932.—The reflecting spectra of monochromatic kathode rays of high volts energy from the cleavage faces of some crystals were obtained by means of the rotating crystal method. From the deviation from Bragg's law the refractive indices of the crystals for the kathode rays of different wave-lengths were determined. The inner potentials were found to be 7·7, 9·1, 11·9 and 12·4 volts for rock-salt, gypsum, stibnite and calcite respectively. [See also Abstract 606 (1931).] AUTHOR.

2095. Intensity of the Interference of Fast Kathode Rays and Simple Apparatus for Demonstration Purposes. F. Kirchner. *Phys. Zeits.* 32. *pp.* 969–971, *Dec.* 15, 1931.—The different types of electron interference patterns obtainable from thin polycrystalline and single crystal films are discussed. F. J. W.

2096. Electron Diffraction Demonstration Apparatus. C. J. Phillips. *Physics,* 2. *pp.* 48–51, *Jan.,* 1932.—An apparatus is described for the class-room demonstration of electron diffraction photographs obtained from thin metallic films and using the range 2000 to 15,000 volts. It is very simple to build and reasonably stable. The method of operation is explained. AUTHOR.

2097. Diffraction of Slow Electrons by Crystals of Calcite and Aragonite. W. Dames. *Ann. d. Physik,* 12. 2. *pp.* 185–210, *Jan.* 2, 1932. —Diffractions experiments are performed with electrons of 20 to 300 volts velocity by the method of fixed angles over a considerable range of angles for calcite and aragonite. By varying the conditions of the experiment it is shown that the maxima are reproducible, and are obtained independent of the time and the previous treatment of the crystals (electrification, heating or irradiation). The 36 maxima for calcite may be represented by an internal potential $E_0 = -11 \cdot 9 \pm 3$ volts, which is independent of the velocity. In the case of aragonite it is necessary to introduce two internal potentials; for the (010)-surface, $E_{01} = -7 \cdot 5 \pm 2$ volts, and $E_{02} = -11 \cdot 8 \pm 2$ volts (45 maxima), and for the (110)-surface $E_{01} = -7 \cdot 7 \pm 2$ volts and $E_{02} = -13 \cdot 0 \pm 2$ volts (52 maxima). H. L. B.

2098. Diffraction of Electrons by Single Crystals of Gold and Platinum. J. J. Trillat and T. v. Hirsch. *Comptes Rendus,* 194. *pp.* 72–74, *Jan.* 4, 1932.—Alterations in the structure of gold crystals in gold leaf, during annealing, are followed by means of the patterns produced on a fluorescent screen by a beam of electrons diffracted by the gold leaf. On annealing between 400° C. – 500° C., the figures produced by single crystals become clearer due to the removal of deformations. Above 500° C. the large crystals are broken up into small ones and complete Debye-Scherrer rings are obtained. The diffraction patterns due to cold platinum foil are also studied and exhibit two orientations of the cubic crystals, whereas in gold foil only one is found. A certain crucial experiment supports the view that the phenomena are due to diffraction of electrons by a three-dimensional grating. N. D.

2099. Point of Stability of the Potential of an Isolated Electrode in a Triode. G. A. Beauvais. *Comptes Rendus,* 194. *pp.* 357–360, *Jan.* 25, 1932.—If one of the electrodes of a triode is isolated and the other electrode is raised to a high potential with respect to the filament, the isolated electrode may take up either of two different potentials for which there is a condition of stable equilibrium. One of these potentials is near that of the filament and the other is very near that of the other electrode, but always a little below it. The following are typical results obtained with a Fotos valve: The stable potential of the isolated grid is 450 volts with the anode at 550 volts, 650 with the anode at 700 volts and 800 with the anode at 900 volts. The stable potential of the isolated anode is 600 volts with the grid at 750 volts and 808 with the grid at 900 volts. There is no stable potential, other than zero, for the anode with a grid potential below 500 volts. The effects can be explained either by an emission of secondary electrons due to electrons from the filament striking the electrode at the high potential, the secondary electrons then reaching the other two electrodes and particularly the isolated one; or by ionisation of the residual gas and the creation of positive charges which, acted on by the electric field, reach the electrodes of lower potential than that of the anode. A. W.

2100. External Photoelectric Effect in Triodes. Q. Majorana. *N. Cimento,* 8. *pp.* 363–369, *Dec.,* 1931.—The author describes some unexplained effects observed with triodes illuminated by intermittent light. In addition to the internal effect [see Abstract 1651 (1929)] he has also observed an external effect due to bodies exposed to such light and connected to the grid of the first of the amplifying valves, or even held at a distance of a few mm. He used a 1000-volt lamp which gave an illumination of as much as a million lux. The beam was interrupted by means of a perforated aluminium disc at the rate of 5 to 600 periods per second. An ordinary photoelectric cell, with sodium and an inert gas, held in the beam by the leg of the positive pole while the negative is insulated, makes a loud sound in the amplifier, provided the beam falls on the sodium itself. A

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triode provided with a " getter " of magnesium shows the phenomenon almost as well. The author attempts no explanation, but proposes to continue the investigation. E. E. F. d'A.

2101. Field and Photoelectric Effects at External Boundary Surfaces. R. Suhrmann. *Phys. Zeits.* 32. *pp.* 929–937, *Dec.* 1, 1931. —The spectral distribution of the photoelectric sensitivity is found to depend in a peculiar way on the thickness in the case of thin aluminium layers, and external fields influence the number of electrons that are emitted. Many curves are given to show the effect of thin layers of naphthalene and paraffin on the photoelectric action of potassium. A qualitative account is given of the selective photoelectric effect. Curves are also given for atomic layers of sodium and potassium on platinum. H. L. B.

2102. Photoelectric Effect. T. Sakai. *Phys. Math. Soc. Japan, Proc.* 14. *pp.* 7–13, *Jan.*, 1932. *In English.*—A wave function which A. Sommerfeld used in his recent paper [see Abstract 575 (1932)] is applied to the photoelectric problem. Certain definite integrals which come into the problem can be easily evaluated without any assumption about the magnitude of the wave-length of the incident light. The results agree with those obtained by J. Fischer [see Abstract 2701 (1931)]. AUTHOR.

2103. Red Shift of the Photo-Ionisation of Alkali Atoms by Adsorption at Negative Surfaces of Salts. J. H. de Boer and M. C. Teves. *Zeits. f. Physik,* 73. 3–4. *pp.* 192–200, *Dec.* 2, 1931.—The photoemission of alkali metals adsorbed by the surfaces of salts is regarded as a photo-ionisation of individual adsorbed alkali atoms. Hence it is comparable with that of alkali vapours. With negative salt surfaces, the ionisation potential is lowered and there is a red shift of the limit of photoionisation, as compared with the values for atoms in vapours. These results are ascribed to the energy provided by the adsorption of positive alkali ions by the negative surface. A similar explanation of the " inner photoelectric effect " in salt crystals is given. This may account for the red shift of the photoelectric conductivity curve of blue rock-salt, containing colloidal and non-atomic Na, compared with the curve for " compact " Na. The mechanism of the emission of electrons at the external surface of an adsorbed layer is discussed. N. D.

2104. Photoelectric Properties of Thin Films of Alkali Metals. S. Asao. *Physics,* 2. *pp.* 12–20, *Jan.*, 1932.—Measurements are reported on the colour sensitivities of various photoelectric tubes having kathodes made of alkali metals. A composite surface of R-Ag-RO-Ag of any alkali metal R shows a higher sensitivity over a wider range of wave-lengths than R-RO-Ag and has two peaks, one between 330 and 370 mμ, and one at about 500 mμ for potassium and 550 mμ for rubidium and between 700 and 800 mμ for cæsium. If a gas-filled lamp at 2700° K. is used as a light source, photoelectric currents from vacuum photo-tubes are obtained sometimes as large as 29 μA per lumen for potassium, and 10–15 μA per lumen for rubidium, and 40–50 μA per lumen for cæsium. It is also reported that the potassium cell in combination with a proper filter would constitute a means for an ideal photometer. AUTHOR.

2105. Photoelectric and Thermionic Properties of Palladium. L. A. DuBridge and W. W. Roehr. *Phys. Rev.* 39. *pp.* 99–107, *Jan.* 1, 1932.—The photoelectric and thermionic properties of pure palladium were studied during an extended outgassing in high vacuum. The threshold, obtained by extrapolation of spectral sensitivity curves, shifted from below 2300 Å. to above 3000 Å. and then back to a final value of 2486 Å. as outgassing progressed. In the final state the photocurrents excited by monochromatic light increase with temperature, the relative increase being greater for the longer wave-lengths. At the higher temperatures the spectral sensitivity curves approach the axis asymptotically. The results are shown to be in excellent agreement with Fowler's recent theory [see Abstract 3584 (1931)] and his method of analysis yields the value 4·97 ± 0·01 volts for the true work function (2486 Å.). The thermionic work function for the clean specimen was found to be 4·99 ± 0·04 volts, and the value of the constant A is very close to 60 ampere/cm.^{2} deg.^{2} [See also following Abstract.] AUTHORS.

2106. Further Experimental Test of Fowler's Theory of Photoelectric Emission. L. A. DuBridge. *Phys. Rev.* 39. *pp.* 108–118, *Jan.* 1, 1932.—Fowler's theory of photoelectric emission [see Abstract 3584 (1931)] is discussed from the viewpoint of the experimental physicist and several significant consequences of the theory in analysing experimental data pointed out. A new graphical method of testing the theory is suggested. This method makes it possible to determine the "true" photoelectric threshold of a surface from photocurrent-temperature curves taken at a single incident frequency, eliminating the necessity of measuring relative intensities of spectral lines. The method is applied to new experimental data on palladium and to Morris' data on gold and found to be completely successful, thus furnishing additional verification of Fowler's theory. [See preceding Abstract.] AUTHOR.

2107. Effect of Red and Violet Light on Photoelectric Cells. Q. Majorana. *N. Cimento*, 8. *pp.* 370–376, *Dec.*, 1931.—Marx and Meyer recently [see Abstract 2429 (1931)] described the behaviour of photoelectric cells under the action of light of several different wave-lengths. They attribute this behaviour to the space charge due to the photoelectric effect. It is difficult to reconcile this theory with the fact of the independence of the phenomenon on the presence of a noble gas in the cells. The author quotes experiments on 20 different cells of various makes which show that red light may impair or cancel the action of violet light. E. E. F. d'A.

2108. Influence of Polarised Light on Blocking-Layer Photoelectric Cells. L. Bergmann. *Phys. Zeits.* 33. *pp.* 17–19, *Jan.* 1, 1932. —The photoelectric current from blocking-layer selenium or other cells is proportional to the amount of light absorbed. The amount of polarised light reflected and refracted at various angles of incidence is known, and the refraction at the surface of a selenium cell should be a measure of the light absorbed and the electrons liberated. The author therefore allowed polarised light to fall upon one of his selenium blocking-layer cells and measured the photoelectric current for various angles of incidence. When the electric vector was parallel to the plane of incidence the absorption was invariably greater than when normal to it. In the former case the absorption, as indicated by the photoelectric current, increased to a maximum at about 75°. In the latter case there was a steady falling off with increasing angle of incidence. The values could not be calculated as the absorption coefficient and the refractive index of the selenium were not accurately known. If $n = 3 \cdot 2$ and $k = 0 \cdot 25$, there is a general agreement with theory, and the residual errors may be attributed to the fact that the surface of the selenium was not perfectly plane. E. E. F. d'A.

2109. Thermionic Emission and Space Charge. N. H. Frank. *Phys. Rev.* 39. *pp.* 226–236, *Jan.* 15, 1932.—The theory of thermionic currents for a plane parallel electrode arrangement including space-charge effects is developed by using Fermi–Dirac statistics and by taking into account the wave-mechanical nature of the electron. The use of the Wentzel–Kramers–Brillouin approximate solution of the Schrödinger equation leads to results quite analogous to those of the classical calculations. The current-voltage characteristic is but slightly different but the expressions for potential distribution (and hence space charge, field energy, density, etc.) are appreciably modified by wave mechanics. AUTHOR.

2110. Hull's Magnetron. L. Pincherle. *Accad. Lincei, Atti,* 14. *pp.* 290–293, *Oct.,* 1931.—A mathematical paper in which a method is given for the theoretical determination of the wave-length of the oscillations of highest frequency (electronic oscillations) emitted by the magnetron of Hull in the case of the magnetic field parallel to the axis of the diode. J. J. S.

2111. Static Conversion of D.C. into A.C. M. Boella. *Elettrotecnica,* 19. *pp.* 33–36, *Jan.* 15, 1932.—Diagrams are given to explain the function of the controlling electrode in the mercury vapour rectifying valve. The possibility and method of using this valve in connection with large currents are reviewed, particularly in respect of the transmission of energy to a distance by means of direct h.t. currents. H. M. B.

2112. Behaviour of Electric Waves in Passage Through an Ionised Gas. W. Hasselbeck. *Ann. d. Physik,* 12. 4. *pp.* 477–502, *Jan.* 21, 1932.—The absorption of electric waves of wave-length 2–6 cm. in passage through an ionised gas is investigated in its dependence on the electron density and the frequency. It is shown that agreement between the experimental results and theory is only obtained quantitatively under certain assumptions. The experimental results are discussed under the assumption of an elastic bonding of the electrons, as proposed by Gutton and recently established experimentally by Tonks and Langmuir. From absorption measurements at two different frequencies, large compared with the natural frequency arising from the elastic bonding, an estimate of the electron density in the discharge was made. The results thus obtained are compared with others obtained by the probe method. A. W.

2113. Magnetic Properties of the Cobalt Atom. H. Vatter. *Zeits. f. Physik,* 73. 3–4. *pp.* 260–272, *Dec.* 2, 1931.—The result of a Stern–Gerlach experiment carried out with atomic rays of cobalt indicates a multiplet structure for the deposit. The maximum magnetic moment of the cobalt atom is calculated to be $5 \cdot 8$ Bohr magnetons. J. S. G. T.

2114. Magnetism and Valency. Part I. Copper and Silver Compounds. S. Sugden. *Chem. Soc., J. pp.* 161–170, *Jan.,* 1932.—From the results of measurements of the magnetic susceptibilities of ten compounds of copper and nine of silver at room-temperature, together with published data, it is found that both copper and silver in the univalent condition have zero magnetic moment, whilst the bivalent atoms of these elements exhibit moments of $1 \cdot 72 - 2 \cdot 16$ Bohr units, in fairly good agreement with the value predicted for one unbalanced electron. The value found by Klemm for the susceptibility of $[Ag4py]S_2O_8$ is 16 % higher than that obtained by the author, but, like his value for $[Ag2(o\text{-phenanthroline})]S_2O_8$, is of the right order for a substance containing an element with unit (Bohr) magnetic moment. Klemm finds that AgO is feebly paramagnetic, whereas the author has so far obtained only diamagnetic specimens. T. H. P.

2115. Magnetic Saturation Phenomena at Very Low Temperatures. O. Halpern. *Ann. d. Physik*, 12. 2. *pp.* 169–180, *Jan.* 2, 1932. —A theoretical discussion based largely on the experimental results of Onnes and Woltjer [see Abstract **998** (1924)]. The magnetic behaviour of gadolinium sulphate at high and very low temperatures is deduced with the aid of quantic statistical considerations. The value of the magnetic moment agrees with that derived from spectroscopic data. The discussion is extended to the connection with Nernst's theorem, the magnetocaloric effect at low temperatures, the possible appearance of magnetic phenomena in rare earths and the deviation from Curie's law. G. E. A.

2116. Magnetostriction of Cold Drawn Wire. J. S. Rankin. *Roy. Techn. Coll. Glasgow, J.* 2. *pp.* 587–589, *Jan.*, 1932.—This continuation of a previous paper [see Abstract **2043** (1931)] gives in more detail the magnetostriction of mild steel wires which have been subjected to progressive degrees of wire drawing. AUTHOR.

2117. Relative Permeability of Iron, Nickel and Permalloy in H.F. Electromagnetic Fields. E. M. Guyer. *Frank. Inst., J.* 213. *pp.* 75–88, *Jan.*, 1932.—The relative magnetic permeability of iron, nickel and permalloy was measured over the range of wave-lengths from 70 to 200 m. by the heterodyne balance method and by the resonance method. Nothing suggestive of the anomalous dispersion of the magnetic permeability reported in this region by Wwedensky and Theodortschik [see Abstract **763** (1923)] was found when certain precautions were observed in carrying out the measurements. When these precautions were neglected irregular breaks resulted in the curves of permeability as a function of wave-length which varied in position with the conditions of the circuit. The h.f. resistance of iron, nickel and permalloy wires was measured over the range of approximately 50,000 kc. from 2–3 m. wave-lengths. What appeared to be anomalous variations at certain frequencies were found not to exist when the proper precautions were observed in making the measurements. AUTHOR.

2118. Magnetic Susceptibility of Binary Alloys. F. L. Meara. *Physics*, 2. *pp.* 33–41, *Jan.*, 1932.—The magnetic susceptibilities of eight series of alloys: tin-thallium, antimony-thallium, thallium-cadmium, zinc-cadmium, lead-antimony, tin-antimony, cadmium-antimony and zinc-antimony have been investigated by Gouy's method. In three series —antimony-cadmium, antimony-zinc and tin-antimony—an intermetallic compound is indicated by an abrupt change in the slope of the susceptibility concentration curve. The compounds thus indicated are SnSb, CdSb, and ZnSb with some evidence for the compound Sn_2Tl. There is nearly a linear relation between the susceptibility and the concentration of one of the constituents where the constituents form simple heterogeneous mixtures—a result best illustrated in the zinc-antimony series of alloys. AUTHOR.

2119. Direct Measurement of Susceptibility of Liquids by the Curie-Chéneveau Magnetic Balance. C. Chéneveau and C. Courty. *Comptes Rendus,* 194. *pp.* 75–76, *Jan.* 4, 1932.—An experimental note on the utilisation of the balance for the determination of magnetic susceptibilities by direct comparison with a substance of known susceptibility and of exactly equal volume. The method is used for benzine and CCl_4 and the results compared with previous observers. Briefly the method consists of putting equal volumes of the liquids to be measured in tubes and measuring the force necessary to balance. The samples under test are then replaced by a similar tube containing a liquid of known susceptibility and by direct arithmetic the values sought can be found. The method is similar to that of Webster and Kapitza in principle. S. G. B.

2120. Temperature Variation of the Magnetic Susceptibility, Gyromagnetic Ratio, and Heat Capacity in Sm^{+++} and Eu^{+++}. Amelia Frank. *Phys. Rev.* 39. *pp.* 119–129, *Jan.* 1, 1932.—Calculations of the magnetic susceptibilities in Sm^{+++} and Eu^{+++} inclusive of second order Zeeman terms, previously made at T = 300° K. only, are extended to include values over a temperature range 0°–800° K. The value assigned to the screening constant used in computing the multiplet intervals is adjusted to make the theoretical susceptibilities agree as closely as possible with experimental data. This fixes the separation between the lowest two levels with less uncertainty than in existing spectroscopic estimates. The computations show that Sm^{+++} should exhibit an unusual behaviour in that, whereas at low temperatures the susceptibility decreases rapidly with increasing temperature, a minimum is reached between 375° K. and 450° K. The theoretical values of the temperature coefficients of susceptibility in Sm^{+++} and Eu^{+++} (both of which are much lower than the Curie value $1/T$) are in satisfactory agreement with experiment when the second order Zeeman terms are included. The other elements in the rare earth group do not deviate appreciably from the Curie law. The present computations show an increase in the gyromagnetic ratio in Sm^{+++} with increasing temperature, in contrast with the behaviour in Eu^{+++} in which increasing temperature decreases this ratio. The temperature variation of the contribution of the multiplet levels to the heat capacity of Sm^{+++} and Eu^{+++} is also calculated. AUTHOR.

2121. Odd and Even Numbers of Electrons. Susceptibilities of Praseodymium and Neodymium Sulphate-Octahydrates at Low Temperatures. C. J. Gorter and W. J. de Haas. *K. Akad. Amsterdam, Proc.* 34. 9. *pp.* 1243–1248, 1931. *Comm. No.* 218*b from the Phys. Lab., Leiden.*—Kramers showed that a total removal of the degeneracy of an energy level of a system of electrons is only possible when the number of electrons is even. In the group of rare earths homopolar bindings do not occur, and it may therefore be expected that for paramagnetic dilution they would furnish the ideal case of the Kramers treatment. The susceptibilities of $Pr_2(SO_4)_3 \cdot 8H_2O$ and $Nd_2(SO_4)_3 \cdot 8H_2O$ were determined from ordinary temperatures down to 14° K. At the lowest temperatures the susceptibility of the Pr salt became nearly independent of the temperature, whilst the Nd salt showed increasing dependence upon the temperature at low temperatures. This is ascribed to the non-degeneration of the lowest energy level of the Pr''' ion in this salt, and agrees with the Kramers theory stated above. At higher temperatures the law of Curie-Weiss is followed giving for the Pr salt $\chi'(T + 32\cdot0) = 45\cdot35 \times 10^{-4}$, which gives $p = 17\cdot90$ W.M., and for the Nd salt $\chi'(T + 45\cdot0) = 45\cdot10 \times 10^{-4}$, which gives $p = 17\cdot94$ W.M. At low temperatures a characteristic difference exists between the behaviour of the susceptibility of the two salts, that of the Pr''' salt becoming nearly independent of temperature, whilst the curve for the Nd''' salt in the $1/\chi'$ against T diagram becomes steeper as is the case in Ce salts. From the results it may be concluded that the temperature-independent paramagnetism of van Kleck has less influence than might be expected in view of the screening constant usually accepted. S. G. B.

2122. Susceptibilities of Cerium Chloride and Praseodymium Sulphate at Low Temperatures. C. J. Gorter, W. J. de Haas and J. van den Handel. *K. Akad. Amsterdam, Proc.* 34. 9. *pp.* 1249–1253, 1931. *Comm. No.* 218*c, from the Phys. Lab., Leiden.*—The susceptibilities of $CeCl_3$ and $Pr_2(SO_4)_3$ were measured between the temperatures 373° K. and 14° K. The behaviour of $CeCl_3$ is analogous to CeF_3. At the higher temperatures the substance follows the law: $\chi(T - 21\cdot0) = 31\cdot81 \times 10^{-4}$, and the number of Weiss magnetons is 12·46. At lower temperatures the $1/\chi' - T$ line is curved towards the T axis. With $Pr_2(SO_4)_3$ the equation $\chi(T - 45\cdot0) = 57\cdot43 \times 10^{-14}$ holds, and the number of magnetons is 18·00. The number of electrons is even, and according to Kramers non-degenerated terms may occur. [See also Abstract 1384 (1931).] G. E. A.

2123. Assumed Paramagnetic Anomaly of Nickel Sulphate Heptahydrate at Low Temperatures and the Types of Deviation from the Law of Curie-Weiss. C. J. Gorter, W. J. de Haas and J. van den Handel. *K. Akad. Amsterdam, Proc.* 34. 9. *pp.* 1254–1258, 1931. *Comm. No.* 218*d from the Phys. Lab., Leiden.*—The paramagnetic behaviour of nickel sulphate heptahydrate has previously been examined by Jackson, and his results are now called into question. Repetition and redetermination, as well as extension of the magnetic measurements, reveal no striking anomalies, and the previous measurements at the temperatures of liquid ethylene and liquid nitrogen must have been in error. At temperatures higher than those of liquid nitrogen the salt follows closely the Curie-Weiss law, with $\theta = -3\cdot0$ and $p = 16\cdot01$. Jackson's results have been corrected accordingly. The different types of anomalies found at low temperatures are enumerated and described. S. G. B.

2124. Paramagnetic Organic Compound. J. Kenyon and S. Sugden. *Chem. Soc., J. pp.* 170–171, *Jan.*, 1932.—An organic compound which is strongly paramagnetic, and the molecule of which has a magnetic moment very close to the value predicted for one unbalanced electron, namely, $\mu = 1\cdot73$ Bohr magnetons, has been examined. T. H. P.

2125. Development of Ferromagnetism in the Manganese-Nitrogen System. R. Ochsenfeld. *Ann. d. Physik,* 12. 3. *pp.* 353–384, *Jan.* 8, 1932.—An experimental investigation of the ferromagnetism using the Tobusch magnetometer and a specially constructed oven. If manganese is strongly heated in nitrogen there is a considerable absorption of nitrogen by Merck-manganese at 1100° C. and by Gayler-manganese at 1060° C. The resulting material is ferromagnetic in both cases. The heating is carried out at 1100° C. and at 12·8 atmospheres pressure. At 1300° C. the nitrogen was again released, whereupon the material again became non-magnetic. The magnetic type shows a more or less γ structure of manganese with a strong approximation to the cubic lattice. The nitrogen absorption creates an increase in the lattice parameter from 3·772–3·857 Å. units. The relationship between the lattice broadening and the magnetisation which affords a measure of the amount of N absorption is, within limits, linear. The β phase of manganese, which is not distended by N absorption, is a mixed crystalline body, and no magnetism or very little is created by similar treatment to the above. The magnetic solutions from Merck-manganese can be molten at 1250°–1270° C. and the magnetic values determined, since the material is available in measurable form. Manganese showed when heated in methane for 30 minutes at 725° C. a very small magnetic effect. The X-ray pictures for all materials discussed are given and in the case of Mn − B (25 % B) material gave a new form of lattice, not yet fully examined. Later work by Schenck-Munster showed a definite compound to be formed having the formula Mn_8N_2. Experimental and theoretical details are fully given. S. G. B.

2126. Disperse Ferromagnetics. H. Sachse. *Kolloid Zeits.* 58. *pp.* 18–22, *Jan.*, 1932.—Mixed precipitates of a ferromagnetic substance (Fe_3O_4 or Fe) with non-magnetic carriers, such as aluminium hydroxide, silica gel, or strontium sulphate, are the less readily magnetisable as the ferromagnetic present becomes more highly disperse. On ageing at room temperature, or more rapidly at 75°, the magnetisability of the precipitates increases. T. H. P.

2127. Theory of the Magnetisation Curve of Isotropic Ferromagnetic Bodies in Medium and Strong Fields. R. Gans. *Phys. Zeits.* 33. *pp.* 15–17, *Jan.* 1, 1932.—Heisenberg's theory allows the ferromagnetic unit crystals to be examined from the point of view of magnetostriction, and thenceforth is deduced a theory of the magnetisation curve of single iron crystals. On the same basis, the present paper deduces the theory of magnetisation curves of ferromagnetic isotropic bodies, taking as example the particular case of cobalt, which crystallise in a hexagonal system. After recapitulation of the Heisenberg postulates, the author works on the assumption that the ferromagnetic isotrope is built up by regular crystals in a regular structure. The paper then resolves itself into a mathematical and theoretical discussion of the points involved.
S. G. B.

2128. Interpretation of Some Ferromagnetic Phenomena. F. Bitter. *Phys. Rev.* 39. *pp.* 337–345, *Jan.* 15, 1932. *Paper read at the Ferromagnetic Symposium, Am. Phy. Soc., Schenectady, Sept.*, 1931.—A discussion of the phenomena of ferromagnetism on the basis of atomic structure in the light of modern theory. Beginning with an expression

$$I_\omega/I_0 = \tanh \mu_B/KT \,.\, (H + N_\omega \,.\, I_\omega)$$

where I_ω is the Weiss magnetisation, I_0 the absolute saturation, K the Boltzmann constant, μ_B is a Bohr magneton, and N_ω is a proportionality factor called the Weiss molecular field constant, the author develops his formula for the different sets of conditions and illustrates them by actual examples due to many other workers. After discussing atomic and molecular structure in relationship to magnetic phenomena he reviews the methods of determination of the magnetic moment of the ferromagnetic atoms, finally discussing initial susceptibility in relation to temperature, magnetostriction, and other relevant matters. A critical review of the subject. [See also following Abstract.] S. G. B.

2129. Verification of the Theory of Magnetisation of Single Crystals. F. Bitter. *Phys. Rev.* **39.** *pp.* **371–375,** *Jan.* **15, 1932.** *Abstract. Paper read at the Ferromagnetic Symposium. Am. Phys. Soc., Schenectady, Sept.,* 1931.—The procedure is reviewed on the basis of an earlier contribution to the discussion [see preceding Abstract] for not only the construction of the magnetisation curves of single crystals, but also to predict the magnetisation produced by any field acting on a crystal in any direction. A scheme is proposed from which the representation of the main features of the deviation effect in crystals is inferred. Furthermore, certain departures from symmetry requiring further investigation have been established. Studies of magnetisation of single crystals in large fields in the neighbourhood of the axes of difficult magnetisation should supplement studies of initial susceptibility, both quantities depending on the distribution of magnetised regions among minima of E_θ, H differing only slightly in depth. I_n for fields nearly parallel to a direction of difficult-magnetisation may probably be found to be structure-sensitive. S. G. B.

2130. New Experimental Methods in Ferromagnetism. S. L. Quimby. *Phys. Rev.* **39.** *pp.* **345–353,** *Jan.* **15, 1932.** *Abstract. Paper read at the Ferromagnetic Symposium, Am. Phys. Soc., Schenectady, Sept.,* **1931.**—A description of methods for observation of magneto-elastic, mechanical and thermal properties of single crystals of nickel, as well as polycrystalline samples of the same metal. The preparation of pure nickel for test purposes is detailed, and experimental work thereon is described, including thermal, elastic and magnetic characteristics. A piezoelectric method is employed. The paper is an efficient summary of the properties of single crystals of nickel. S. G. B.

2131. Barkhausen Effect. Orientation of Magnetisation in Elementary Domains. R. M. Bozorth. *Phys. Rev.* **39.** *pp.* **353–356;** *Disc.,* **375–376,** *Jan.* **15, 1932.** *Abstract. Paper read at the Ferromagnetic Symposium, Am. Phys. Soc., Schenectady, Sept.,* 1931.—The postulate of the elementary domain by Weiss and the discovery of the discontinuous nature of the magnetisation process by Barkhausen have led to many investigations regarding the nature of the elementary regions in each of which the magnetisation changes as a unit. The experimental side now described deals with the sizes of the domains, the extent to which the domain is localised in space, the extent to which it is saturated in one direction, and the orientation of the magnetisation vector before and after the change. Nearly all of the change in magnetisation takes place in jumps, at least on the steeper portions of the hysteresis loop, and that the volume of the domain varies but little with the conditions of the iron being sometimes smaller by thousands of times, and sometimes larger than the crystal by the same order of magnitude. The present work quotes evidence that the elementary domain is a region well localised in space, within the whole of which the elementary magnets reverse. The author then reviews the data supporting the statements above and indicates lines for future work. S. G. B.

2132. Propagation of Large Barkhausen Discontinuities. K. J. Sixtus and L. Tonks. *Phys. Rev.* **39.** *pp.* **357–358;** *Disc.,* **375–376,** *Jan.* **15, 1932.** *Abstract. Paper read at the Ferromagnetic Symposium, Am. Phys. Soc., Schenectady, Sept.,* **1931.**—The formula for the time of penetration for a large travelling Barkhausen discontinuity has been recalculated on the assumption that at each point in the discontinuity in the wire the resultant of the impressed field H and the eddy current field is the critical field H_0. The formula now reads:

$$\delta t = 3 \cdot 94 \times 10^{-8} a^2 \Delta I / \rho (H - H_0)$$

where a is the radius of the wire, ΔI the change in induction, and ρ the specific resistance. The numerical coefficient is thus doubled. Oscillograms taken, however, fail to verify the formulæ resulting, in that t is proportional to a rather than to a^2. Empirical substitution of the value $0 \cdot 031a$ for a^2 reproduces the experimental values well. Probably the assumption regarding the magnetic field balance at the discontinuity of the wire needs revision, or the existence of a field arising from the distribution of magnetic pole strength along the wire should be considered. Two parameters are of particular significance in the propagation of large discontinuities, namely, H_0 the critical field below which no propagation could be obtained, and the constant A giving the slope of the velocity field curve. In the wires investigated, the change in H_0 with tension, heat treatment, etching, etc., is very similar to the change in coercive force in ferromagnetic wires which have small discontinuities, but the slope varied differently from that suggestive of other known properties of the material. A record is given of a series of experiments bearing on slope variation with etched wires. The slope increased from 50 to 100 % for wires etched from 15 mil down to 14·8 and 5 mil, and this could not be attributed to reduction of diameter nor absorption of hydrogen. Finally it is concluded that in experiments with etched wires the applied tension cannot produce a perfect alignment in the surface of the wire on account of irregular cracks, and in the other set of experiments with a circular field, the latter presumably produced a deviation from perfect alignment resulting in an increase in slope. S. G. B.

2133. Effect of Impurities on Ferromagnetism. T. D. Yensen. *Phys. Rev.* 39. *pp.* 358–363; *Disc.*, 376–377, *Jan.* 15, 1932. *Abstract. Paper read at the Ferromagnetic Symposium, Am. Phys. Soc., Schenectady, Sept.*, 1931.—Elements present in, or added to iron, may generally be divided into two classes depending on the position they occupy in the iron space lattice. Firstly, those elements which take the place of iron atoms and are known as substitution elements. Secondly, there is a class of elements which are sufficiently different from iron to prevent their atoms from falling into the ranks of the iron atoms, and yet there are indications that to a small extent they become entangled in the iron lattice. Such elements are called interstitial elements, on the assumption that they occupy the position between the iron atoms. C, O, S and N are thus included. If the solubility range is exceeded they are precipitated from solution as compounds of iron, Fe_3C, FeS, FeO, etc., as the temperature drops. This class of elements the author terms impurities, and the application of the term is extended to nickel and cobalt also. The effect of small amounts of impurities on the saturation value is very small, but their effect on the initial and maximum permeabilities and on the coercive force and hysteresis loss is very great. The order of magnitude of these factors is illustrated. In order to account for the large effect of minute amounts of carbon particles on the magnetic qualities, it is assumed that the carbon atom occupying the interstitial spaces in the iron lattice has a distorting effect, and that the regularity of the lattice accounts for the magnetic effects. It is suggested that carbon deposited as Fe_3C and remaining in the lattice can have a greater distortional effect on the lattice than the single carbon atoms. The same applies to N, O and S, but the available data are very meagre. The author concludes with a reference to a nickel-iron alloy known as " hypernik " where the maximum permeability and hysteresis losses are in the ratio of 20/1, the former reaching a value of 167,000. Details of the preparation, etc., are given. S. G. B.

2134. Hydrogenised Iron. P. P. Cioffi. *Phys. Rev.* **39.** *pp.* **363–367**; *Disc.*, **376–377**, *Jan.* **15, 1932.** *Abstract. Paper read at the Ferromagnetic Symposium, Am. Phys. Soc., Schenectady, Sept.*, **1931.**—Single crystals of iron grown by the McKeehan method with high-temperature heat treatments in hydrogen were found to have better magnetic characteristics than single crystals grown at lower temperatures or in a vacuum, due to the treatment and not to grain size. Iron of high initial and maximum permeability can now be produced regardless of grain size and orientation. Thus for a ring of " Armco " iron quoted the initial and maximum permeabilities were 4000 and 180,000 respectively, the coercive force was 0·025 gauss and the hysteresis loss for B_m 14,000 was 190 ergs./cm.^{3}/cycle. With regard to hydrogenisation, there is reason to believe that there is an optimum pressure of hydrogen for every temperature of treatment. C, S, P, O and N are reduced to small quantities by hydrogen temperature treatment if prolonged. The most satisfactory treatment is apparently in the presence of water vapour, *i.e.*, when hydrogen is saturated with the vapour at room-temperature. Hydrogenised iron is as soft as annealed copper. Grain growth is more pronounced, ranging from 0·04″ to 0·2″. The magnetic characteristics of hydrogenised iron are dependent upon the cross section of the metal, the maximum permeability rising rapidly with the thickness. The effect of lowering the temperature of the hydrogenised iron to that of liquid air is to create a comparatively small diminution of permeability. The fact that a large decrease of temperature is accompanied by a relatively small diminution of permeability makes it appear unlikely that the characteristics of hydrogenised iron are due to thermal impacts between the absorbed hydrogen and iron atoms. S. G. B.

2135. Magnetisation and Thermal E.M.F.s. S. R. Williams. *Phys. Rev.* **39.** *p.* **368**, *Jan.* **15, 1932.** *Abstract. Paper read at the Ferromagnetic Symposium, Am. Phys. Soc., Schenectady, Sept.*, 1931.—Curves obtained to show the thermal e.m.f. developed between transversely and longitudinally magnetised wires by the Seass method are discussed. The present effect was predicted by Thomson, and a related phenomenon is the v. Ettingshausen–Nernst effect in which a heat flow perpendicular to a magnetic field in the conductor causes a potential gradient parallel to the heat flow. These two effects are correlated as regards bismuth, antimony and carbon with interesting results as regards conductivities. The conclusion is drawn that temperatures measured by thermocouples in magnetic fields are not reliable unless the elements are unaffected by the field, there being displacement for a number of elements in the thermoelectric series by being placed in a magnetic field. Relations with magnetostriction and magneto-resistance are sought. S. G. B.

2136. Magneto-Strain and Magneto-Resistance. L. W. McKeehan. *Phys. Rev.* **39.** *pp.* **368–371**, *Jan.* **15, 1932.** *Abstract. Paper read at the Ferromagnetic Symposium, Am. Phys. Soc., Schenectady, Sept.*, **1931.**—The dimensions and electrical conductivities of a ferromagnetic body are affected in two ways by its magnetisation. The conspicuous effects at temperatures far below the Curie points are anisotropic. As regards direction along which magnetisation increases, longitudinal and transverse effects are opposite in sign. Longitudinal magneto-strain varies in sign according to the nature of the material, but the longitudinal magneto-resistance is always positive. The anisotropic magneto-strains are most evident in monocrystal specimens, their signs and magnitude depending upon the orientation of the magnetisation vector with respect to the crystallographic axes. In polycrystal specimens anisotropic elastic strains affect the anisotropic magneto-strains and magneto-resistances, as well as the magnetic permeability. It is suggested that other things being equal, a ferromagnetic alloy with vanishing magneto-strains will be found very easy to magnetise and little energy will be required for traversing the hysteresis loop. The conspicuous magneto-strains and magneto-resistances in the neighbourhood of the Curie points are, at least in cubic crystals, isotropic. This isotropic magneto-strain may be of either sign. The isotropic magneto-resistance is negative, *i.e.*, the resistance increases as the magnetisation diminishes with rise of temperature. A full discussion follows regarding orientations of atoms by which such phenomena may be explained. In conclusion it is stated that we are still justified in postulating a mechanism capable of explaining the exchange interaction integral of Heisenberg's theory by the mutual potential energy of non-spherical atomic fields in special orientations. S. G. B.

2137. Sliding of a Periodic Electric Influx along a Cylindrical Axis. R. Ferrier. *Comptes Rendus,* 194, *pp.* 65–67, *Jan.* 4, 1932.—It is considered whether the equations of electrodynamics permit an electric disturbance of given frequency, possessing axial symmetry, to slide along a cylinder with any velocity, without being dissipated laterally. The components of the magnetic field of the disturbance at a point are assumed to have certain forms which contain an arbitrary constant a, and an unknown function of the distance ρ of the point from the axes. By substitution in Maxwell's equations and developing in series, the function is found and also the components of the electric field. So long as a is greater than 1, outside the cylinder, the energy is not dissipated laterally. Inside, this condition is fulfilled for all values of a. In these cases a disturbance slides along the cylinder, which serves as a guide. Special cases are considered and the possibility of solving a more general problem is discussed. N. D.

2138. Determination of the Specific Charge of the Electron from Measurements of Velocity. F. Kirchner. *Ann. d. Physik,* 12. 4. *pp.* 503–508, *Jan.* 21, 1932.—In order to reduce the uncertainty in the measurements of e/m_0 due to the fact that the contact potential between the incandescent kathode and the anode is not known, the author made a series of measurements of the emission current, which he has plotted as a function of the voltage up to about 10 volts. The form of the curve indicates that the $V^{3/2}$ law holds approximately, provided that the curve is shifted a certain amount to one side. He assumes that the amount of this shift measures the contact potential, and using this value in his former experiments obtains the value $e/m_0 = (1 \cdot 7585 \pm 0 \cdot 0012) \times 10^7$ e.m.u. A new series of measurements was made using a special new piezoelectric quartz resonator. The result obtained is $e/m_0 = (1 \cdot 7590 \pm 0 \cdot 0015) \times 10^7$

e.m.u. These values agree well with new measurements using the Zeeman effect communicated to the author by Sommerfeld. H. N. A.

APPARATUS AND INSTRUMENTS.

2139. Lindemann Electrometer. F. Müller and K. Geissler. *Zeits. f. Elektrochem.* 37. *pp.* 857–861, *Dec.*, 1931.—The authors have studied in detail the use and accuracy of this instrument. The various sources of error are gone into, including those due to imperfect adjustment of the zero point, want of insulation, imperfect earth, variations in temperature, air currents, incomplete proportionality between voltage and deflection, low velocity of the needle, and in particular the effect of the cover glasses, which, unless they have a certain amount of conductivity, are apt to hold electric charges and affect the readings. The best results are obtained by means of the null method when, under suitable conditions, the errors can be reduced to 0·1 mV. H. N. A.

2140. Theory of the Ballistic Electrometer. H. Benndorf and F. Burger-Scheidlin. *Ann. d. Physik*, 12. 3. *pp.* 265–282, *Jan.* 8, 1932.—The ballistic galvanometer can be compared with a pendulum which receives a blow while it is in the position of rest. The authors show that the ballistic electrometer can be compared with a pendulum which, after being pulled out of its position of rest by an inextensible thread, is pulled towards the opposite side by a spiral spring, and begins its movement when the thread is suddenly cut. Full details are given for the measurement of a charge q, suddenly imparted to the system, from the deflection observed. H. N. A.

2141. Measurement of the Quantities of Electricity Given Out by the Geiger Counting Tube. F. Burger-Scheidlin. *Ann. d. Physik*, 12. 3. *pp.* 283–305, *Jan.* 8, 1932.—Makes use of the theory of the ballistic electrometer [see preceding Abstract], and shows how the ballistic reduction factor can be calculated. The method has been practically tested, and it has been found possible to obtain an accuracy within 3 %. It is necessary to calibrate the whole system ballistically; in the case of the ballistic galvanometer it is only necessary to calibrate the galvanometer. H. N. A.

2142. New Electrometer. K. Grant. *Journ. Sci. Instruments*, 9. *pp.* 17–19, *Jan.*, 1932.—The construction, mode of use and properties of a small static electrometer are described. The moving element has the form of a " multi-needle," and is characterised by extreme lightness and very small moment of inertia. AUTHOR.

2143. New Galvanometer Shield. C. Moerder. *Zeits. f. Instrumentenk.* 51. *pp.* 606–612, *Dec.*, 1931.—When testing insulation resistance or testing materials under high voltages many methods while decreasing the risk of damage do not prevent it. The apparatus described by the author works without inertia, for it depends on the action of an electronic valve. It prevents the passage of an excess current, and its range of action extends to that of the highly sensitive instruments and it is especially good for h.t. measurements. It consists essentially of two movable high resistances and a normal triode valve, and the strong damping of the resistances makes a disturbing oscillation in the valve impossible. The whole network is placed in the circuit in front of the galvanometer. The theory and the method of operating the apparatus are described. R. S. R.

2144. Characteristics of the Oscillograph-Galvanometer. V. S. Thomander. *Frank. Inst., J.* 213. *pp.* 41–55, *Jan.*, 1932.—The paper describes the mechanical characteristics of the vibrator for any periodic phenomena, so that the mechanical error due to the vibrator may be eliminated from the oscillogram and the true phenomena determined. The paper establishes the best damping to use, when considered from the standpoint of vibrator response, lag and transient characteristics. There is a method given to determine the vibrator resonance and damping that may easily be applied in the field. Curves are supplied from which all the above-mentioned may be obtained. AUTHOR.

2145. Electrostatic Voltmeter. W. W. Nicholas. *Bureau of Standards, J. of Research*, 8. *pp.* 111–118, *Jan.*, 1932.—An electrostatic voltmeter possessing several unique features is described. The size is a minimum, since the p.d. is applied to two electrodes, the arrangement of which is analogous to concentric spheres. The inner electrode is supported on the end of an insulating bushing introduced through the outer electrode, which is a metal can and contains a suspended dumb-bell rotated by electrostatic repulsion, as in the Coulomb torsion balance. The deflection is read by means of a mirror, which, for convenience in mounting the instrument at a safe height, may be placed at the lower end of the insulating bushing. For purposes of automatic control, the dumb-bell may be connected mechanically with an apparatus at ground potential. The design may be adapted to the use of high gas pressures, desirable in the measurement of very high voltages. The sensitivity of the instrument is discussed, and calibration curves are given for various suspensions. AUTHOR.

2146. Generating Voltmeter for the Measurement of High Potentials. P. Kirkpatrick and I. Miyake. *Rev. Sci. Instruments*, 3. *pp.* 1–8, *Jan.*, 1932.—The voltmeter consists of a simple armature rotating in an electrostatic field and a galvanometer for measuring the current produced. The instrument is calibrated by X-ray quantum voltages, and the curve between these voltages and the galvanometer currents is linear; so the instrument is semi-absolute in that its calibration may be deduced without reference to a high-voltage meter. The voltmeter draws no current from the high potential source, its accuracy is almost that of the galvanometer, and its range extends from zero to high voltages by shunting the galvanometer; temperature effects are negligible. H. M. B.

2147. Apparatus for Measuring Small Deformations. A. Guillet. *Comptes Rendus*, 194. *pp.* 67–70, *Jan.* 4, 1932.—The small deformations are measured by replacing them by quantities of induced electricity. The problem is to " translate " one into the other in a definite way. A comparator is described, in form resembling a balance, which involves electromagnetic translation. Its application to measurements of Young's modulus is discussed. Translators of linear and rotational movements are considered separately. The actual readings are simply those of galvanometer deflections, and suitable circuits are described. [See also Abstract 1402 (1932).] N. D.

2148. Improvements in the Curie-Chéneveau Magnetic Balance. F. W. Gray and J. Farquharson. *Journ. Sci. Instruments*, 9. *pp.* 1–5, *Jan.*, 1932.—The following improvements are described for the magnetic damping type of Curie-Chéneveau balance: adjustment of the suspension; adjustment of the damping magnet; use of other torsion wires; use of other methods of attaching the torsion wire; use of lamp of low voltage; micrometric control of the horse-shoe magnet; cure for electrostatic faults; temperature control. AUTHORS.

2149. Large Permanent Magnet for Experiments on the Deflection of α- and β-Particles. G. H. Briggs. *Journ. Sci. Instruments*, 9. *pp.* 5–8, *Jan.*, 1932.—A description is given of a large permanent magnet using 36 % cobalt magnet steel and designed for experiments on the deflection of α and β particles. The magnet gives a field of 5300 gauss between poles of area $26 \times 7 \cdot 95$ cm. and $1 \cdot 19$ cm. apart. By reversing the poles the gap may be altered to $26 \times 17 \cdot 8$ cm. with fields up to 2500 gauss. The method of calculating the amount of magnetic steel required is outlined. The field actually obtained was within 1 % of that expected theoretically. During a period of eight months the field increased by about 1 in 500, an effect which may be due to a fall in temperature. AUTHOR.

2150. H.T. Supply for Geiger Counters Operated from A.C. Mains. H. C. Webster. *Cambridge Phil. Soc., Proc.* 28. *pp.* 121–123, *Jan.*, 1932.—Geiger-Müller tube-counters were satisfactorily operated from ordinary a.c. mains and a description is given of the method employed for keeping the voltage constant. J. J. S.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

2151. Thermo-Stromuhr Method of Measuring Blood Flow. J. F. Herrick and E. J. Baldes. *Physics*, 1, *pp.* 407–417, *Dec.*, 1931.—For physiological purposes it is often necessary to measure the blood flow through a particular organ. Various methods, as described in textbooks of physiology, have been developed for this purpose, but suffer from the defect that they require the insertion of part of the apparatus into the blood stream, the use of anticoagulants, and interference with the normal body temperature. Rein has derived a method which does not suffer from these defects, employing an apparatus called the thermo-stromuhr. Briefly this method depends upon the application of a known heat energy, as developed by diathermy machines, and the measurement of the heat passing *via* the blood vessel by means of a thermo-element, which surrounds, but does not enter, the actual blood stream. Particulars of the construction of these thermo-elements are given. The subject of the flow of heat in a cylinder *via* which a fluid is passing is developed from a mathematical aspect and this is applied to the flow of blood *via* a blood vessel, although in this case the problem is not so simple as the purely theoretical case. The method has been applied in experiments on animals to determine the blood flow *via* the kidney under certain experimental conditions, the results of which are to be published in a journal of physiology. B. J. L.

2152. Two-Valve Transformer Unit for Diagnosis and Therapy. W. E. Schall. *Brit. J. of Radiology*, 4. *pp.* 711–714; *Disc.*, 714, *Dec.*, 1931.—This unit, designed for either 150 kV for therapy or 75 kV for diagnostic work, comprises a centre-tapped h.t. transformer which by the operation of a suitable h.t. switch may be used either as a single-valve circuit or a bi-phase circuit employing two valves. In the latter case one pole of the X-ray tube is earthed. G. E. B.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

2153. Active Carbon. S. Roychoudhury and I. N. Mukherjee. *Zeits. f. phys. Chem.* 157. *Abt.A.* 5–6. *pp.* 435–441, *Dec.*, 1931.—This work refers to the determination of the electrical charge of samples of active charcoal. The results obtained are discussed with reference to adsorption powers. Reference is made to the work of Schilow, Kruyt and Kadt, Frumkin and Dubinin. Details are given for the purification of the different samples and it is shown that their charges change according to the electrolytes present. Contrary to the work of Frumkin, the results obtained cannot be explained on the theory of gas electrodes. [See following Abstract.] J. K.

2154. Active Carbon. A. Frumkin, R. Burstein and P. Lewin. *Zeits. f. phys. Chem.* 157. *Abt.A.* 5–6. *pp.* 442–446, *Dec.*, 1931.—The exceptions to Frumkin's theory [see preceding Abstract] are critically examined. New experimental results are brought forward as to the dependence of the adsorption of acid on the amount of oxygen present. The authors conclude that there is no need to modify the views previously arrived at by earlier workers. J. K.

2155. Phase-Boundary Surfaces, Lines and Points. W. Ostwald. *Zeits. f. phys. Chem.* 158. *Abt.A.* 1–2. *pp.* 91–96, *Dec.*, 1931.—A theoretical discussion of the conditions under which these may be set up. F. J. W.

2156. Adsorption of Ions of Radioelements and Dyestuffs. K. Fajans and T. Erdey-Grúz. *Zeits. f. phys. Chem.* 158. *Abt.A.* 1–2. *pp.* 97–151, *Dec.*, 1931.—The laws on adsorption are considered. In connection with adsorption of dyestuff-ions the principle of titration with adsorption indicators, the effect of electrolytes in dyestuff adsorption, the parallelism between the degree of adsorption and difficulty of solubility of analogous ions, and comparison of ions of different constitution are all considered. Reference is made to the adsorption rule of Hahn. The methods of investigation in adsorption of the radioelements adopted heretofore are criticised. The results obtained on the adsorption of dyestuff-ions by the silver halides are given and discussed. The adsorption of ThB^{++} from a weak saltpetre solution by AgBr, AgI, Ag_2S, $AgIO_3$, Ag_2CrO_4, $Ag_2C_2O_4$ and Ag_3PO_4 is investigated. The effect of various electrolytes on this adsorption is also investigated. J. K.

2157. Adsorption of Gases and Gas Mixtures on Wood Charcoal. A. Magnus and A. Krauss. *Zeits. f. phys. Chem.* 158. *Abt.A.* 3–4. *pp.* 161–196, *Jan.*, 1932.—The adsorption of acetylene, ethylene, methyl ether and carbon dioxide on wood charcoal is investigated by a consideration of the isotherms obtained for various temperatures. A new apparatus is described which permits the investigation of the adsorption of mixtures and allows the behaviour of acetylene–methyl ether mixtures towards wood charcoal to be examined. The charcoal used was purified. The adsorption is measured for various pressures up to about one atmosphere. The data obtained for acetylene, ethylene and carbon dioxide satisfy the adsorption formula of Magnus. [See Abstract 801 (1930).] J. K.

2158. Adsorption of Gases and Vapours on Plane Surfaces. C. E. H. Bawn. *Am. Chem. Soc., J.* 54. *pp.* 72–86, *Jan.*, 1932.—The adsorption of CO, O_2 and A on mica surfaces was measured at pressures ranging from 1×10^{-4} cm. to 2×10^{-2} cm. and at temperatures of 90° and 193° Absolute. The data for the adsorption of CO and O_2 at 90° Absolute agreed with the Langmuir formula. The results for A could not be expressed by a simple formula. The thickness of the adsorbed film of each gas was not greater than unimolecular. The adsorption of acetone vapour on mica was also studied, and the results indicated that the adsorbed layer was not greater than one molecule in thickness. F. J. B.

2159. Sorption of Carbon Disulphide at Low Pressures by Activated Charcoals. A. J. Allmand and J. L. Lizius. *Roy. Soc., Proc.* 134. *pp.* 554–570, *Jan.* 2, 1932.—The sorption measurements have been carried out on six different kinds of charcoal. In every case, at pressures below 10^{-1} mm., the heat of sorption rises continuously as the charge on the charcoal decreases. Above 10^{-1} mm. the decrease is sharp. The amounts of CO_2 removed from the charcoals by charging with CS_2 are much greater than those found in the corresponding experiments with CCl_4. Further, the removal of CO_2 is not accompanied by a drift in the adsorption isothermals. F. J. W.

2160. Adsorption of Organic Materials to the Silver Halides. S. E. Sheppard, R. H. Lambert and R. L. Keenan. *J. Phys. Chem.* 36. *pp.* 174–184, *Jan.*, 1932. *Kodak Research Lab. Comm. No.* 481.—Study of the adsorption of pinacyanol, a basic dye, to silver bromide at pH 6·8 and calculation of dye adsorbed to Br^- of the octahedral surface shows that 1·69 Br^- is necessary for one dye molecule. Calculations are also made of total surface, assuming both cubic and octahedral faces of silver bromide. Qualitatively it is shown that an acid dye such as dichlorofluorescein adsorbs to AgBr only for excess Ag^+ and mainly in an acid medium. Pinacyanol adsorbs mainly in alkaline medium and for an excess of Br^-. Although allylthiourea does not follow any adsorption formula in its addition to the silver halides, the nature of the substances formed and the solubility of the various compounds are such that in some cases the reaction does not proceed to completion. It is found that gelatin adsorbs to silver bromide and, when the halide is prepared in presence of gelatin, a layer of gelatin about the grain is so formed that it cannot be removed by boiling with water for many hours. H_2SO_4 (10 %) does not remove all the adsorbed material even after six hours' digestion, although the grains are markedly altered. Enough gelatin is still present after water digestion to amount to a monomolecular layer about the grain. T. H. P.

2161. Microtome Method of Determining the Absolute Amount of Adsorption. J. W. McBain and C. W. Humphreys. *J. Phys. Chem.* 36. *pp.* 300–311, *Jan.*, 1932.—No method has previously been available for determining the absolute amount of adsorption at a static air-water interface, and thus direct confirmation of the validity of the Gibbs adsorption theorem has been impossible. In the method now described the solution is maintained in a state of rest for any desired period in a shallow vessel of which the inside is coated with paraffin wax. Owing to the curvature of the air-solution surface it is possible to remove a uniform layer of solution of 0·05-0·1 mm. in thickness by means of a microtome blade travelling at about 35 ft. per sec. From the difference of concentration of the solution thus removed and that remaining, determined with the interferometer, the absolute amount of interfacial adsorption may be calculated. Measurements with solutions of hydrocinnamic acid, caproic acid, phenol and *p*-toluidine yield results for the absolute adsorption which are very close to those calculated from the Gibbs equation, whereas the figures obtained by various other workers for dynamic surfaces are 2–3 times as great. The Gibbs equation thus appears to be a limiting law applicable to static surfaces. H. F. G.

2162. Heats of Adsorption of Oxygen on Nickel and Copper Catalysts. W. W. Russell and O. C. Bacon. *Am. Chem. Soc., J.* 54. *pp.* 54–71, *Jan.*, 1932.—The adsorption of oxygen at 0° C. on catalytically active nickel and copper surfaces was studied. The thermal measurements were made in a modified Bunsen calorimeter. It was found that relatively large amounts of gas were rapidly and irreversibly taken up with the evolution of a considerable amount of heat. Molar heats of oxygen adsorption amounted to 98,000 cal. and higher, and 82,000 cal., in the case of nickel and copper respectively. Surfaces, previously poisoned by saturation with oxygen at 0° C., were regenerated by simply heating to a suitable temperature range. They were then capable of again adsorbing relatively large amounts of oxygen at 0° C. with only moderately reduced thermal effects. F. J. B.

2163. Monomolecular Films: Solid-Liquid Interface and Sedimentation and Flocculation of Powders in Liquids. W. D. Harkins and D. M. Gans. *J. Phys. Chem.* 36. *pp.* 86–97, *Jan.*, 1932.—Dry finely powdered titanic oxide in dry benzene remains flocculated, 1 c.c. of the oxide settling to a bulk of 20 c.c. Addition of sufficient oleic acid to form a monomolecular film on the oxide causes deflocculation and settling to 5 c.c.; vibration reduces these bulks to 8 and 3 c.c. respectively, and makes re-suspension difficult, thus explaining "hard-settling" paints. [See Abstract 362 (1930).] The surface area of such a powder is determined from the amount of oleic acid adsorbed from a benzene solution thereof, the adsorbed film being monomolecular. A sealed glass tube containing dry titanic oxide in dry benzene when shaken vigorously gave a 3 mm. spark when brought near the hand; this does not occur if oleic acid is present. C. A. S.

2164. Monomolecular Films: Liquid-Liquid Interface and Stability of Emulsions. E. K. Fischer and W. D. Harkins. *J. Phys. Chem.* 36. *pp.* 98–110, *Jan.*, 1932.—By direct count and measurement of some 50,000 globules in emulsions of benzene or paraffin oil in sodium oleate solution the interfacial area was determined. From this and the amount of oleate adsorbed the interfacial film is shown to be monomolecular. [See Abstract 3670 (1929).] C. A. S.

2165. Solubility of Gas and Coefficient of Dilatation by Absorption. J. Horiuti. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 341. *pp.* 125–256, *Dec.*, 1931. *In English.*—An extensive series of measurements has been made of the solubility and dilatation which occur on dissolution of hydrogen, nitrogen, carbon monoxide, methane, ethane, ethylene, acetylene, carbon dioxide, nitrous oxide, dimethyl ether, and sulphur dioxide in various organic solvents, including carbon tetrachloride, chlorobenzene, benzene, acetone, methyl acetate, diethyl ether and, in some

cases, chloroform. Ångström's rule, *viz.*, that the ratio of the coefficients of dilatation of any pair of gases is independent of the nature of the solvent, and Just's rule of a similar relationship for the solubilities, are valid only for the gases of low boiling point. The order of the solvent powers of the solvents is for the solutes hydrogen, nitrogen and carbon monoxide identical with that of the critical temperatures of the solvents. With increase of the boiling point of polar or unsaturated solutes polar solvents containing oxygen rise, and normal solvents fall, in the order of dissolution capacity; with normal solvents the reverse obtains. For the detailed thermodynamic considerations which have been applied to the results of the measurements the original paper must be consulted.
H. F. G.

2166. Thermodynamics of Concentrated Solutions. Part I. Eutectic Systems. E. Kordes. *Zeits. f. phys. Chem.* 158. *Abt.A.* 1–2. *pp.* 1–34, *Dec.*, 1931.—This paper deals with eutectic systems and is based on a relationship derived between the van't Hoff equation for the lowering of the freezing point and the empirical general equation previously found by the author for the position of the eutectic in binary systems. It is also shown that the position of the eutectic point can now be approximately calculated in numerous systems by means of the fusion temperatures and heats of fusion of the pure components. H. H. Ho.

2167. Theory of the Ludwig-Soret Effect. B. Bružs. *Zeits. f. phys. Chem.* 157. *Abt.A.* 5–6. *pp.* 422–434, *Dec.*, 1931.—Consideration of the Ludwig–Soret effect in the light of thermodynamic principles and the laws of stationary heat-flow shows that the Soret coefficient of a solution can be predicted from the purely thermodynamic properties of the solution. It is shown also that, like the Peltier, Seebeck, Hittorf and other effects, the Ludwig–Soret effect represents a special case of a general dynamic effect. T. H. P.

2168. Density, Inner Friction, Dielectric Constant, Dipole Moment, Dissolving Power and Dissociating Power of Hydrocyanic Acid. K. Fredenhagen. *Am. Electrochem. Soc., Trans.* 60. *pp.* 153–163; *Disc.*, 163, 1931.—Little is known about the behaviour of salts in solvents other than water. The classic researches of Kahlenberg and Schlundt [see Abstract 525 (1903)] are analysed. A number of their experiments are repeated and new ones added. Determinations are made of the dielectric constant and the dipole moment of pure distilled HCN. The density and internal friction of the acid are determined, and then solubilities and conductivities of various salts in HCN are measured. These new results in general check those of Kahlenberg and Schlundt and are also in accord with the author's researches with liquid NH_3 and HF as solvents. AUTHOR.

2169. Influence of Air on the Properties of Organic Solvents. J. Horiuti. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 342. *pp.* 257–264, *Jan.*, 1932. *In English.*—Solvents treated in the atmosphere usually contain air as one of the impurities. Air is about 6 to 19 times as soluble in organic solvents as in water. The influence of air therefore must be carefully considered. Quantitative results on the density and the vapour pressure are given and discussed. J. K.

2170. Ultracentrifuge. J. B. Nichols. *Indust. and Engin. Chem.* (*Analytical Ed.*), 4. *pp.* 12–17, *Jan.*, 1932.—A somewhat detailed account is given of the principles involved in the design of the ultracentrifuge, and of its application for the study of the distribution of particle size in colloidal solutions by refractive index or photographic or visual colorimetric methods of measuring the concentration changes. Constructional details are given of certain machines capable of producing fields of force of from 10,000 g. to 100,000 g. A review of the subjects which have been studied with the aid of the apparatus includes: the sedimentation of carboxy-hæmoglobin; the differentiation of monodisperse and polydisperse substances; the influences of changes of acidity or alkalinity on micelles; the separation of mixtures of micelles; the determination of the micellary weights of proteins, complex dyestuffs, and cellulose and its derivatives; and the mechanism of the formation and growth of colloidal particles. H. F. G.

2171. Theory of the Micellar State and Chemical Complexity. G. Malfitano and M. Catoire. *Kolloid Zeits.* 57. *pp.* 266–276, *Dec.*, 1931. —The theory of the micellar state now developed contains the following hypothesis: In addition to atoms, molecules and complex molecules or polymers or complexes, there is a fourth kind of material species which is called a " micelle " and which is a kind of complex of complexes and polymer of polymers. The latter is the characteristic component of the ordinary colloidal or micellar state. This theory is shown to unite the four previous theories of dispersoids, macro-molecules, micro-crystals and ionogenic complexes into a single conception; and is expressed in the following terms: the material unit or the chemical individual consists of a definite number of other material units of lower grades which can be united with a definite number of material units of the same grade with formation of a unit of higher grade. This viewpoint is very comprehensively discussed. H. H. Ho.

2172. Rhythmic Separation of Stearic Acid from Alcoholic and Ethereal Solution. A. Kutzelnigg. *Kolloid Zeits.* 57. *pp.* 292–293, *Dec.*, 1931.—From a hot alcoholic solution containing 100 gm. of stearic acid in 70 cc. or from a saturated ethereal solution, the acid separates in the form of concentric rings. The phenomenon appears to be caused by the alternation between progressive cooling and the liberation of the heat of crystallisation. T. H. P.

2173. Rhythmic Splitting of Silicic Acid Gels. E. C. H. Davies. *J. Phys. Chem.* 35. *pp.* 3618–3630, *Dec.*, 1931.—Silicic acid splits rhythmically whenever setting and synæresis are accompanied by sufficient contraction to cause any splitting, and if the initial splitting occurs along a line not coinciding with the inside circumference of the tube or one of its diameters. Rhythmic splitting is general whenever the gel is allowed to set in other than the vertical position. It has been found that the observed length of a rhythmic split is about 1·5 times that of a true sine curve. The wave-length is shown to be nearly the same for all angles of setting. A photograph of rhythmic splits is shown. J. K.

2174. Synæresis of Silica Gel. D. G. R. Bonnell. *Faraday Soc., Trans.* 28. *pp.* 1–19, *Jan.*, 1932.—Reference is made to the observations of Graham and Ostwald and to the work of Ferguson and Applebey [see Abstract 1397 (1931)] on volume changes on synæresis. The velocity of synæresis and the final equilibrium are quantitatively studied by a new type of synærometer. The effect of the silica concentration of silicic acid gels upon the progress of synæresis is investigated. The gels are prepared by the action of hydrochloric, sulphuric and acetic acids on sodium silicate. The volume changes accompanying synæresis are also investigated. After referring to the work of Holmes, Kaufmann and Nicholas, Kuhn, Mukoyama, Ferguson and Applebey on acidic, neutral and basic gels, the effect of hydrogen-ion concentration of the gel on synæresis of silica gels of various concentrations over a wide range of pH values is investigated. It is found that the iso-electric point for silica gels of the concentrations studied lies between pH 7·5 and 8·9. The effect of temperature on synæresis is also investigated. J. K.

2175. Improved Sedimentation Method for the Determination of Particle Sizes Using an Automatic Recorder. C. G. Sumner. *Faraday Soc., Trans.* 28. *pp.* 20–27, *Jan.*, 1932.—The sedimentation tube method, making use of Stokes' law, was first used by Wiegner. Reference is also made to the further work of Ostwald and Hahn, Kelley, Kraemer and Stamm, and Lambert and Wightman. In the present work an automatic recording camera is applied to the determination of particle sizes by this sedimentation method. The improved technique adopted is fully described with reference to two drawings of the apparatus. J. K.

2176. Structure of Rubber and other Elastic Colloids. G. S. Whitby. *J. Phys. Chem.* 36. *pp.* 198–214, *Jan.*, 1932.—In the present paper current views on the structure of rubber are considered. It is pointed out that any general view on the structure of rubber should be applicable to other colloids having similar elastic properties unless good reasons can be given to the contrary. It is also pointed out that the structure of other colloids should be of use in elucidating the structure of rubber. Reference is made to the work of, among others, Freundlich, Hauser, v. Weimann, Weber, Caspari and Whitby. J. K.

2177. Nature of Simple Chemical Bonds. E. Bergmann and L. Engel. Reply by A. Weissberger. *Zeits. f. phys. Chem.* 15 . *Abt.B*, 2–3. *pp.* 85–102, *Dec.*, 1931.—A method is discussed for obtaining a relationship between the dipole moment of non-rigid molecules and their spatial structures, and in particular for diphenyl compounds, disubstituted ethanes, and benzene derivatives with different substituents. The dipole moments have been determined of the optically active 6:6′-diamino-2: 2′-ditolyl (1·66), *p*-chloroanisole (2·24), *p*-chlorobenzoic acid ethyl ester (2·00), *p*-chlorobenzyl chloride (2·11), and *p*-nitrobenzyl chloride (3·63). The work of Weissberger in this connection [see Abstract 3337 (1931)] is discussed, some corrections are included on a later page (*loc. cit.*, *p.* 248). The reply of Weissberger contains objections to the calculations of Bergmann and Engel, and, in support, the data for the dipole moments of the stereoisomeric stilbene dichlorides bis (α-chlorobenzyl) benzenes are included. H. H. Ho.

2178. Reactions of Hydrocarbons in the Glow Discharge. E. G. Linder and A. P. Davis. *J. Phys. Chem.* 35. *pp.* 3640–3672, *Dec.*, 1931. —In this paper a theory of chemical action in the glow discharge is presented and an apparatus described for subjecting hydrocarbons in the gaseous phase to the glow discharge and collecting the reaction products. Data on 57 hydrocarbons are given. In a series of similar compounds of increasing molecular weight (*e.g.*, the normal paraffins), the rate of gas evolution per unit current increases with the molecular weight, whereas in a series of the same molecular weight (*e.g. o-*, *m-* and *p*-xylene), it increases with decreasing centralisation. The increase in the rate of gas evolution with molecular size is attributed to the increasing ability of the larger molecules to absorb energy in other ways than by ionisation, *i.e.*, to their larger number of degrees of freedom. The amount of insoluble solid formed has been found to increase generally with decrease in the hydrogen to carbon ratio of the original hydrocarbon. Analyses are given of the gases evolved in the glow discharge for 47 hydrocarbons. H. H. Ho.

2179. Existence and Preparation of Lead Suboxide. P. Pascal and P. Minne. *Comptes Rendus*, 193. *pp.* 1303–1305, *Dec.* 21, 1931.—The measurement of the magnetic susceptibility of lead suboxide, Pb_2O, prepared either by decomposition in a vacuum of lead oxalate at 275° or by reduction of lead oxide by phenylhydrazine, shows that only in the former case is a pure specimen obtained. By the second method metallic lead is formed, the amount varying with the period during which the reduction proceeds. The pure suboxide has density 8·38 at 18° C., and magnetic susceptibility $-0{\cdot}09 \times 10^{-6}$. H. F. G.

2180. Atomic Hydrogen. Part III. Mercury Hydride. A. Klemenc and F. Patat. *Zeits. f. phys. Chem.* 158. *Abt.A.* 1–2. *pp.* 65–77, *Dec.*, 1931.—Attempts to obtain chemical evidence of the formation of mercury hydride from mercury and irradiated hydrogen show that under the conditions of the experiment the compound has a partial pressure of not more than 25×10^{-6} mm. The unimolecular velocity coefficient of the formation of the hydride is of the order of 10^{11} (units: sec.mol./cm.^{3}), so that the possibility of occurrence of a chain of reactions having periods greater than about 10^{-9} sec. is excluded. All reactions in the system mercury-hydrogen which take place under the influence of resonance radiation involve the production of atomic hydrogen. H. F. G.

2181. Ultra-Violet Absorption and Chemical Reactivity of Certain Classes of Organic Compounds. Pauline Ramart-Lucas and J. Hoch. *Comptes Rendus*, 194. *pp.* 96–99, *Jan* 4, 1932.—Measurement of the ultra-violet absorption of members of the series $C_6H_5 . O . [CH_2]_n . CO_2H (n=1, 3, 4, 11)$ and $C_6H_5 . O . [CH_2]_n . O . C_6H_5 (n=1, 2, 3, 5, 10)$ shows that the optical behaviour of the first terms of such series is not the same as that of the first terms of series in which the C_6H_5 radical is linked directly to the carbon atom chain. When the chromophores C_6H_5 and CO_2H are united directly by a carbon atom chain, their mutual influence results in augmentation of the absorption. If, however, the C_6H_5 group is linked to the rest of the molecule by an oxygen atom, the mutual influence of the chromophores results, in all cases, in diminution of the absorption. Marked differences in chemical properties, and especially in the stability of the molecular structure, correspond with these differences in optical behaviour. T. H. P.

2182. Photochemical Polymerisation of Acetylene. S. C. Lind and R. Livingston. *Am. Chem. Soc., J.* 54. *pp.* 94–106, *Jan.*, 1932.—When irradiated by ultra-violet light in the absence of mercury vapour, acetylene is polymerised to a yellowish solid resembling cuprene. Light of 2537 Å. and longer wave-lengths is not effective in producing this polymerisation. The rate of the polymerisation appears to depend only on the intensity of the absorbed light and to be independent of the pressure of the acetylene. When the gas at 10 cm. pressure is exposed to the complete radiation of a quartz-mercury arc, the 10° temperature coefficient has the value 1·25. The quantum yield of the polymerisation, for the average wave-length 2150 Å., is 9·2 ± 1·5, and this value appears to be independent of the pressure of the acetylene and of the intensity of the absorbed radiation. T. H. P.

2183. Photochemical Polymerisation of Cyanogen. T. R. Hogness and L. S. Ts'ai. *Am. Chem. Soc., J.* 54. *pp.* 123–129, *Jan.*, 1932. —The absorption spectrum of cyanogen consists of a series of diffuse bands extending from 2240 Å. to the limit of transmissivity of quartz, and it is concluded that, on absorption of light between 2145 and 2240 Å. cyanogen dissociates either into two normal CN radicals or into one normal and one excited radical. No cyanogen fluorescence was observed. Determinations of the quantitative absorption of light by cyanogen in the region 2145–2240 Å. have been made and the quantum efficiency for the photochemical reaction $(CN)_2 \rightarrow$ paracyanogen is found to be three moles per einstein. The mechanism of the reaction is discussed. T. H. P.

2184. Triatomic Halogen Molecules in Photochemical Reactions. G. K. Rollefson and H. Eyring. *Am. Chem. Soc., J.* 54. *pp.* 170–177, *Jan.*, 1932.—By using the quantum mechanics equation for the potential energy of systems of three atoms, it has been shown that for all the halogens the molecules of the type X_3 are stable at room-temperature with respect to the decomposition into X_2 and X. The significance of this fact has been discussed in connection with the mechanism for the reactions between Cl and H and between Cl and CO. For the H-Cl reaction it has been shown that the mechanism of the reaction is essentially the same for dry gases as for moist. The results of Senftleben and Germer on the optical dissociation of the halogens have been interpreted from the standpoint of the conclusions presented in this paper. H. H. Ho.

2185. Relation between Extinction of Fluorescence and Retardation of Photochemical Reactions. K. Weber. *Zeits. f. phys. Chem.* 15. *Abt.B.* 1. *pp.* 18–44, *Dec.*, 1931.—Quantitative study of the effects of various inorganic and organic substances in extinguishing the fluorescence of sodium naphthionate and quinine sulphate shows that the greater the hydration of the active ions, the weaker the effect. Certain consequences of Perrin's theory on the extinction of fluorescence by foreign substances (dependence on the viscosity and acidity of the solution) are in good agreement with the experimental results, but Bannow's assumption of a salting-out action as the cause of the extinction cannot be confirmed. The velocity with which solutions of Lauth's violet are bleached in presence of acceptor increases markedly with the concentration of the acceptor, the temperature coefficient of the reaction at the same time diminishing. As regards their action on the velocity of this bleaching, substances which have an extinguishing effect on the fluorescence may be classified into the groups: (1) pure de-activation by collision; quinol, pyrogallol, phenol, potassium thiocyanate; (2) electrolyte action: NaCl, KCl, NH_4Cl, $NaNO_3$, etc.; (3) de-activation + electrolyte action: KI, Na_2HPO_4; (4) transference catalysis: $FeSO_4$, cinnamic acid. T. H. P.

2186. Sensitised Photochemical Ozone Formation by Zinc Oxide. G. Jung and E. Kunau. *Zeits. f. phys. Chem.* 15. *Abt.B.* 1. *pp.* 45–50, *Dec.*, 1931.—In certain zinc oxide experiments whereby starch-KI solution became coloured, the cause has been established as due to ozone formation by photochemical action, and not by traces of oxides of nitrogen. Ozone formation is found to take place only when oxygen is exposed to light in the presence of zinc oxide prepared from zinc nitrate, no ozone being generated when the zinc oxide has been made from the sulphate, chloride or carbonate or from pure zinc by oxidation, even when the preparations contain the oxides of copper, iron, manganese or cadmium. The photochemical activity of the zinc oxide from the nitrate decreases with the period and intensity of heating, disappearing entirely when the heating is sufficiently prolonged. Zinc nitrate containing water of crystallisation sensitises the ozone formation, whereas the anhydrous product does not. H. H. Ho.

2187. Spectrum and Photochemical Decomposition of Chlorine Monoxide. W. Finkelnburg, H. J. Schumacher and G. Stieger. *Zeits. f. phys. Chem.* 15. *Abt.B.* 2–3. *pp.* 127–156, *Dec.*, 1931.—The absorption spectrum of chlorine monoxide, measured at different concentrations (600–10 mm. of mercury), is continuous and begins at 6600 Å., with maxima at 6250, 5300, 4100 and 2560 Å.; the last is broad and very intense. The absorption is attributed to initial decomposition into Cl + ClO, the maxima at 5300 and 4100 Å. corresponding with splitting into the same products, but in different stages of excitation. The final intense maximum at 2560 Å. indicates decomposition into Cl + Cl + O. Photochemical decomposition of Cl_2O for the three wave-lengths 436, 365 and 313 $\mu\mu$ is independent of the pressures of Cl and Cl_2O and foreign gases and is proportional to the absorbed light. The quantum yields for the three wave-lengths agree to within 10 %, and amount at 10° C. to: for 436 $\mu\mu$, 3·2; for 365 $\mu\mu$, 3·4; and for 313 $\mu\mu$, 3·5 mol/E, in each case ± 15 %. The same results are obtained whether the light is absorbed by the chlorine or by the chlorine monoxide. The temperature coefficient of the reaction increases as the temperature rises, and at about 200 mm. is 1·1 per 10° for 10–48°, 1·12 for 48–68° and 1·18 for 68–89°. The products of the reaction include, besides Cl, ClO, O and ClO_2, at least one unknown oxide of chlorine. Evidence is cited which indicates that the primary phase of the decomposition yields Cl + ClO. **Errata,** *ibid.*, p. 248, Dec., 1931. T. H. P.

2188. Temperature Coefficient of the Photochemical Formation of Hydrogen Chloride. E. Hertel. *Zeits. f. phys. Chem.* 15. *Abt.B.* 4–5. *pp.* 325–333, *Jan.*, 1932.—The temperature coefficient of the photochemical formation of hydrogen chloride, in oxygen-free gas mixtures by radiation of wave-length corresponding to the visible part of the continuum in the chlorine spectrum, has the value 1·37 ± 0·02; in gas mixtures of high oxygen concentration the value becomes 1·12 ± 0·02; in oxygen-free mixtures, but with wave-lengths greater than the above, the value becomes 1·48 ± 0·04. The experiments of Lind and Livingston [see Abstract 2975 (1930)] are interpreted in the light of the above results. H. H. Ho.

2189. Discontinuous Variations in the E.M.F. of Photovoltaic Cells with Coloured Liquids. A. Grumbach and F. Taboury. *Comptes Rendus*, 193. *pp.* 1178–1180, *Dec.* 7, 1931.—The cells used had platinum electrodes in an acid solution of colouring matter and were of the type described by Grumbach and Schlivitch. A capillary electrometer was employed, using a zero method. It was found that when the e.m.f. of the cell varied it did so in a series of equal steps, being in all cases given by the equation $V = nV_1$ where n is a whole number. When the new cell is kept in the dark V varies irregularly from step to step. Steps of the same magnitude are observed when the cell is illuminated, and when the illumination ceases. [See following Abstract.] H. N. A.

2190. Equidistant Voltage Stages in Photovoltaic Cells. A. Grumbach and F. Taboury. *Comptes Rendus*, 194. *pp.* 84–86, *Jan.* 4, 1932.—The authors have repeated the work described in a recent paper (see preceding Abstract], using a quadrant electrometer instead of a capillary electrometer; the results previously obtained are confirmed. It is suggested that the equidistant voltage steps observed are due to the adsorption of monomolecular layers attracted to the electrode, forming a multiple layer in the original sense of Gouy's theory. The adsorption or the disappearance of one of these layers will produce in all cases the same variation of the potential, " the equidistance V_1." H. N. A.

2191. E.M.F. of the Zinc-Zinc Sulphate/Lead-Lead Sulphate Cell. I. A. Cowperthwaite and V. K. la Mer. *Am. Chem. Soc., J.* 53. *pp.* 4333–4348, *Dec.*, 1931.—The temperature coefficient of the ion size parameter in the theory of Debye and Hückel was determined by the measurements of e.m.f.s of the cell Zn(two-phase amalgam)/$ZnSO_4(m)$/$PbSO_4(s)$/Pb(two-phase amalgam). The e.m.f.s were determined at concentrations of zinc sulphate of 0·0005, 0·001, 0·002, 0·005 and 0·01 *M.*, and at temperatures of 0°, 12·5°, 25°, 37·5° and 50°; also at concentrations of 0·02 and 0·05 *M.* at temperatures of 0°, 25° and 50° C. The results were in excellent agreement with the requirements of the Gronwall, la Mer and Sandved extension of the Debye-Hückel theory. The value of the ion size parameter was found to be constant from 0° to 37·5° C., and equal to 3·64 Å. F. J. B.

2192. Standard Potential of Iron and the Activity Coefficient of Ferrous Chloride. Merle Randall and M. Frandsen. *Am. Chem. Soc., J.* 54. *pp.* 47–54, *Jan.*, 1932.—The electrode potential of iron was determined in a cell arranged to prevent oxidation of the ferrous chloride which formed the electrolyte. Iron was prepared in a high state of purity by the reduction of pure oxide and by electrolysis. Cells of the form: Fe(*s*), $FeCl_2$ 0·1 *N*, $Hg_2Cl_2(s)$, Hg(1) were used, in which both forms of iron were employed as electrodes. The same potential was found for both forms of iron in ferrous chloride solution. The standard potential of iron at 25° C. was found to be 0·4402 volt, and the free energy of formation of ferrous ion to be −20,310 cal. F. J. B.

2193. Silver Chloride Electrode. W. R. Carmody. *Am. Chem. Soc., J.* 54. *pp.* 188–192, *and p.* 210, *Jan.*, 1932.—The method developed for the determination of e.m.f. in dilute aqueous solutions [see Abstract 1658 (1930)] was applied to the case of the silver chloride electrode. By means of a specially designed quartz apparatus the e.m.f. of the cell: Pt, $H_2(g)$, HCl, AgCl(*s*), Ag(*s*), was measured at eight concentrations below 0·01 *N*. From these measurements the value obtained for the potential of the silver chloride electrode was $E^\circ = -0{\cdot}2223$ volt at 25° C. F. J. B.

2194. Theory of the Glass Electrode. M. Dole. *Am. Chem. Soc., J.* 53. *pp.* 4260–4280, *Dec.*, 1931.—The glass electrode is directly compared with the hydrogen electrode in solutions of lithium, sodium, potassium and barium salts at various concentrations and over the pH range 6 to 13. Previous theories of the glass electrode are critically reviewed, and a differential thermodynamic equation is given for it in terms of activities and transference numbers. A new equation for the glass electrode is also established and shown to agree with the data up to a pH of 12. A similar equation may be theoretically derived for univalent salts from the Henderson and Planck liquid junction equations if the relative mobility of the positive ions is assumed to be a function of the hydrogen-ion activity. The idea is put forward that the electric double layer at the glass aqueous solution interface determines the selective mobility of the ions across the boundary. H. H. Ho.

2195. Reaction at the Quinhydrone Electrode in Methyl Alcohol. A. Macfarlane. *Chem. Soc., J. pp.* 3212–3218, *Dec.*, 1931.—The rate of reaction taking place at the quinhydrone electrode was followed by measurements of the e.m.f. of cells of the type Ag/AgCl/HCl in MeOH/quinhydrone/Pt. It was assumed that the primary reaction was the slow oxidation of the hydrogen chloride by the oxygen in solution. A mechanism is suggested to account for the observed rate of reaction. F. J. B.

2196. Elimination of Liquid Contact Potentials with Potassium Chloride and Ammonium Chloride. G. M. Kline, M. R. Meacham and S. F. Acree. *Bureau of Standards, J. of Research,* 8. *pp.* 101–110, *Jan.*, 1932.—The method of employing a 4·1 *N* KCl solution for annulling the contact potentials between HCl and KCl solutions gives results within the present routine experimental errors and uncertainties regarding the contact potentials. The Bjerrum extrapolation correction is over three times as large as it should be, especially if used outside the limit of about 2 mV set by him. The use of the so-called "saturated" 3·5 *N* instead of the 4·1 *N* KCl solution may often leave an error of 1 to 3 mV, or more. In view of the approximately correct, experimentally verified results given by the Loomis-Acree method, its simplicity and rapidity and the avoidance of uncertain extrapolations, its adoption for general use is recommended for annulling contact potentials between (*a*) hydrochloric acid and especially organic salts and buffers on the one hand and (*b*) potassium-chloride or sodium-acid phthalate solutions used in standard or reference electrodes. An approximately isoelectric eliminator, such as $3\,N$ KCl + N KNO_3 should be used between solutions with pH values between 3 and 10. AUTHORS.

2197. Elimination of P.D. at Liquid-Liquid Junctions. J. V. Lakhani. *Chem. Soc., J. pp.* 179–182, *Jan.*, 1932.—Measurements with the calomel electrode in KCl and HCl solution, using a sensitive string galvanometer, show that the e.m.f. at the junction of 2 electrolytes is set up almost instantaneously, and certainly within 5×10^{-3} sec. A simple and reproducible type of flowing junction is described in which five horizontal jets of the two solutions in contact with the electrodes impinge in such a manner that contact is established before the mixed liquid falls. The e.m.f. of the combination is independent of the rate of flow of the solutions. H. F. G.

2198. Electrolytic Dissociation and Activity Functions of Acids in Salt Solutions. Part III. E. Larsson and B. Adell. *Zeits. f. phys. Chem.* 157. *Abt.A.* 5–6. *pp.* 342–362, *Dec.*, 1931.—The functions

$- \log K_a$, $- \log K_{ac}$, $- \log K_c$, $- \log \psi$ and $- \log \phi$ have been determined for a number of aliphatic and aromatic acids in NaCl and KCl solutions by the methods previously described [see Abstract 1464 (1932)]. The influence of the constitution of the acid on $- \log \psi$ and $- \log \phi$ is regarded as the sum of two separate actions. The first, which is intra-ionic, is the action of especially polar atomic groups on the magnitude of the effective ionic radius; this action diminishes as the distance between the atomic group and the ionised carboxyl group increases. The second effect, which is extra-ionic, depends on deformation of the anion of the carboxylic acid by the ions of the NaCl or KCl. T. H. P.

2199. Condition of Molten Salts. P. Walden. *Zeits. f. phys. Chem.* 157. *Abt.A.* 5–6. *pp.* 389–421, *Dec.*, 1931.—The views concerning the condition of molten binary salts as regards association, solvation and dissociation, based on various physical properties, are discussed. The quantitative relationships of the values for the equivalent electrical conductivity to the temperature, viscosity and molecular weight are then considered for the high-melting alkali chlorides and for picrates of the alkylated ammonium bases, melting below 100°. The relation $\lambda\eta\sqrt{M} =$ constant (almost) is thus obtained, λ being the equivalent conductivity at the melting point, η the viscosity, and M the theoretical molecular weight. The same relation holds also for the large-ioned non-solvated tetralkylammonium picrates in aqueous and non-aqueous solutions at infinite dilution. The mobility of the separate ions of these totally dissociated picrates in aqueous solution may be determined by means of the equations $l_{\text{kat.}}\eta \,.\, \sqrt{M_{\text{kat.}}} =$ constant, and $l_{\text{Pi}}\eta =$ constant. By applying these rules to the molten strong picrates, values are obtained for $l_{\text{kat.}}$ and l_{Pi}, and the sum of these gives a calculated conductivity, which, within the limits of experimental error, agrees with the values found for λ at the melting point. Hence, these molten picrates behave as though they were completely dissociated. A similar conclusion is arrived at for the molten alkali chlorides and the like. T. H. P.

2200. Effect of Pressure on the Electrical Conductance of Salt Solutions in Water. W. A. Zisman. *Phys. Rev.* 39. *pp.* 151–160, *Jan.* 1, 1932.—New data are presented for the change with pressure of the equivalent conductance of the following 0·01 *N* salt solutions in water: at 30° C, HCl, LiCl, NaCl, KCl, RbCl, CsCl, NaF, NaBr, NaI, Na_2SO_4, $NaC_2H_3O_2$, $CaCl_2$, $BaCl_2$, $ThCl_4$, $K_3Fe(CN)_6$, $K_4Fe(CN)_6$; and at 75° C., all the above solutions excepting NaF and $ThCl_4$. The pressure range at 30° C. is 1–10,000 kg./cm.^{2}, and at 75° C. it is 1–11,000 kg./cm.^{2} It is pointed out that the observed maxima in the equivalent conductance cannot be entirely caused by a change in the degree of dissociation of the ions with pressure. By using a well-known expression for the equivalent conductance at infinite dilution, and also by using the Debye-Hückel formula, it is shown in each case that there must be a large change in the diameters of the ions due to the pressure if the theory is to agree with the data. AUTHOR.

2201. Limiting Law for Transport Numbers. M. Dole. *J. Phys. Chem.* 35. *pp* 3647–3648, *Dec.*, 1931.—The empirical equations published by Scatchard, Jones and Dole [see Abstract 2872 (1929)], connecting transference numbers of strong electrolytes with the concentration, are developed from theoretical considerations. Starting from the Debye equation $A_1^{\cdot} = A_1^{\infty} - a_1^{\cdot}\sqrt{c}$, it is shown that the equation discovered by Jones and Dole, $t_p = M/\sqrt{c} + N + R$ has the same form as the limiting law. F. J. B.

2202. Transport of Electricity through Phase Boundaries. Part I. Glass-Gas System. E. Manegold and F. A. Schneider. *Zeits. f. phys. Chem.* 158. *Abt.A.* 3–4. *pp.* 197–215, *Jan.*, 1932.—By the use of a glow electrode it is shown that hydrogen could be electrolysed into Thuringia glass at a temperature of 300° C. and at 300 to 500 volts. An apparatus is designed by means of which it is possible to induce the electrolytic migration of hydrogen from the gaseous phase into that of the brittle glass. Similar effects are not obtained with nitrogen or helium. The volume of hydrogen and the quantity of sodium displaced by the hydrogen ions are in accordance with Faraday's law. F. J. B.

2203. Migration Studies with Ferric Oxide Sols. Part I. Positive Sols. F. Hazel and G. H. Ayres. *J. Phys. Chem.* 35. *pp.* 2930–2942, *Oct.*, 1931.—The migration velocity of positive ferric oxide sols has been studied by observation of the movement of single particles under the ultramicroscope, and the effects of H-ion concentration and of addition of electrolytes on the migration velocity have been investigated. H. H. Ho.

2204. Diffusion of Colloidal Electrolytes and Other Charged Colloids. G. S. Hartley and C. Robinson. *Roy. Soc., Proc.* 134. *pp.* 20–35, *Nov.* 3, 1931.—The theory of the diffusion of colloidal electrolytes is discussed and applied to the case of dyes where an extension of the ordinary Nernst equation to multivalent ions is shown to be necessary. If the diffusion of the colloidal dye takes place in the presence of other electrolytes, the potential gradient which arises during the diffusion of the pure dye is reduced with consequent drop in the diffusion coefficient. As the concentration of the added electrolyte becomes large compared with that of the colloidal electrolyte, a limiting case arises where the ions of the colloidal electrolyte diffuse independently, and the relationship between diffusion coefficient and ion radius is then given by the Stokes–Einstein equation; this principle is used for evaluating the particle radius where the degree of aggregation is not influenced by the concentration of electrolyte necessary to eliminate the potential gradient. It is also shown that the influence of the electrical forces on the diffusion coefficient must be taken into account in the case of charged colloids not generally treated as colloidal electrolytes. Bruin's high results for the diffusion coefficients of starch and gum arabic and for the magnitude of the drop in diffusion coefficient on the addition of small quantities of electrolytes, are explained as due to the very high " equivalent weight " of the charged colloid. Normal cases are similarly explained. H. H. Ho.

2205. Influence of Current Strength on Electroosmosis through Palmitic Acid Diaphragms. G. Köhler. *Zeits. f. phys. Chem.* 157. *Abt.A.* 1–2. *pp.* 113–142, *Nov.*, 1931.—According to the Helmholtz–Smoluchowski equation, for a given diaphragm and a given solution, the electroosmotic volume-velocity v should be proportional to the current strength i, *i.e.*, the electrokinetic potential should be independent of i. Measurements with diaphragms of palmitic acid with acetate buffers show that v is not proportional to, but increases with i: $v = ki - v_0 = k(i - i_0)$, where k, i_0 and v_0 $(= ki_0)$ are constants. This result may be explained by assumption of a flow-resistance in the double layer. From Bingham's expression for the shearing strain, a modified Helmholtz-Smoluchowski equation may be simply derived, this indicating that the electrokinetic potential ξ_0 is proportional to $k = (v + v_0)/i$. The apparent electrokinetic potential ξ is hence given by $\xi = \xi_0(1 - i_0/i)$, *i.e.*, ξ increases hyperbolically with i. It appears also that v_0 should be proportional to the total cross-section q of the pores, but measurements at pH $= 4{\cdot}8$ with palmitic acid diaphragms of different pore size gave irregular values for v_0. Both ξ_0 and v_0 are functions of pH and v_0 depends on the dissociation of the buffer acid. Preliminary comparison of electroosmosis through cetyl alcohol and palmitic acid, which contain the same carbon-atom chain, gives, with an acetate buffer of pH 5·4 at 25°, the values for ξ_0 23·5 and 59·0 mV respectively. The values of the streaming potential E determined by Martin and Gortner increase, in some cases, not proportionally to the pressure P but according to the expression, $E = kP - E_0$ (k and E_0 being constants), so that the relation is similar to that observed in the electroosmosis of palmitic acid. T. H. P.

2206. Electrokinetic Potentials. Part X. Effect of Particle Size on Potential. H. B. Bull and R. A. Gortner. *J. Phys. Chem.* 36. *pp.* 111–119, *Jan.*, 1932.—An attempt was made to obtain a standard material for the investigation of electrokinetic phenomena. The electrokinetic potential of quartz was found to depend upon the particle size. Electrokinetic studies were made on ground quartz in an aqueous solution of $0{\cdot}20 \times 10^{-3}\,N$ NaCl. No linear relationship was found for different sizes of quartz particles in a heterogeneous mixture between the pressure forcing the liquid through the quartz diaphragm and the streaming potential. Between a particle size of $4{\cdot}59\,\mu$ and $214\,\mu$ the surface potential was found to increase approximately as the cube root of the diameter.

F. J. B.

2207. Electrokinetic Potentials. Part XI. The Effect of Sodium Soaps on the Electric Moment of the Double Layer at an Aqueous Cellulose Interface. H. B. Bull and R. A. Gortner. *Physics*, 2. *pp.* 21–32, *Jan.*, 1932.—Electrokinetic studies of aqueous solutions of sodium formate, sodium acetate, sodium propionate, sodium butyrate, sodium caprylate, sodium oleate and sodium oxalate have been conducted at a cellulose interface with the streaming potential technique. It is suggested that in interest of clearness and accuracy the attempt to express electrokinetic data in terms of "potentials" be abandoned and that the electric moment of the double layer, which does not require a knowledge of the magnitude of the dielectric constant, be substituted for ζ. It is indicated that after the fourth carbon atom has been added the electric moment of the double layer is essentially a constant. It is noted that there is no correspondence between the ionisation constant of the fatty acid from which the soap is derived and its effect on the electrokinetic conditions at the interface. This indicates that hydrolysis and the resulting OH ion play a minor rôle. It is pointed out that the electric moment of the double layer in the case of the longer chained soaps is almost independent of the concentration whereas those of the short chained soaps are much more sensitive to increased concentration. The maximum electric moment is found at about $2 \times 10^{-4}\,N$. This is true also for a number of salts.

AUTHORS.

2208. Capillary Electrometer and Electrocapillary Curve. Part III. Temperature Variation of the Electrocapillary Curve. F. O. Koenig. *Zeits. f. phys. Chem.* 157. *Abt.A.* 1–2. *pp.* 96–112, *Nov.*, 1931.—The electrocapillary curve of a solution containing 1 mol. KNO_3, 0·00545 mol. $Hg_2(NO_3)_2$ and 0·0064 mol. HNO_3 has been determined at temperatures from 9·3° to 55° [see Abstract 3655 (1931)]. With rising temperature the curve flattens, the maximum is displaced to the left, and σ^P is lowered except at the lower end of the rising branch of the curve, where it increases; the last effect is attributed to the diminution of the adsorption of the mercury salt. With rise of temperature, the depolarisation current flowing through the capillary electrometer increases considerably. The temperature coefficient (negative) of the maximum interfacial tension diminishes numerically with increasing concentration of the foreign electrolyte and increases numerically as the temperature rises. These results, and the dependence of the above temperature coefficient on the capillary activity of the foreign electrolyte [see Gouy, Abstract 300 (1907)] are ascribed to diminution of the adsorption of the foreign electrolyte as the temperature rises. The relationship of the displacement of the maximum on the curve with rising temperature to various theoretical magnitudes, especially the dipole components of the Galvani potential, is explained. T. H. P.

2209. Electrocapillary Curves of Mixtures of Normal Alcohols with Water and Adsorption of the Alcohol Molecules at the Mercury Surface. C. Ockrent. *J. Phys. Chem.* 35. *pp.* 3354–3366, *Nov.*, 1931.—Electrocapillary curves are given for the complete ranges of aqueous solutions of methyl, ethyl and *n*-propyl alcohols and for some concentrations of the partially miscible *n*-butyl alcohol-water system. The calculated areas of the alcohol molecules at the p.d. for which maximum adsorption occurs agree fairly well with the values calculated for insoluble alcohol films on water. For alcohol solutions reaching quite high concentrations, the alcohols appear to form monomolecular layers at the charged mercury surface and are orientated in the same way as the air-water interface. In various alcohol solutions, water appears to raise the interfacial tensions at polarisations more positive than − 0·6 volt and to lower these tensions at polarisations more negative than − 0·6 volt. These effects, which increase in magnitude as the homologous series of alcohols is ascended, may be ascribed to either large liquid junction potentials or a positive adsorption of water at negative polarisations. T. H. P.

2210. Stream Potential Determinations on Glass Capillaries. H. L. White, F. Urban and E. T. Krick. *J. Phys. Chem.* 36. *pp.* 120–129, *Jan.*, 1932.—Measurements were made of the stream potentials exhibited by pyrex capillaries of $4 \cdot 5\,\mu$ to $110\,\mu$ through which 0·0005 N KCl was forced by a pressure of 60 cm. of mercury. A standard method for streaming was developed by means of which reproducible results could be obtained. F. J. B.

2211. Hydrogen and Oxygen Overvoltages on Nickel-Iron Alloys. M. deK. Thompson and A. L. Kaye. *Am. Electrochem. Soc., Trans.* 60. *pp.* 229–234, 1931.—The oxygen and the hydrogen overvoltages of the iron-nickel series of alloys were measured in molal potassium hydrate at 25° C. The hydrogen overvoltages of pure nickel and pure iron in hydrate are considerably lower than in acid. One set of constants in the formula $\eta = a + b \log i$ applies to the whole range of current densities for the hydrogen overvoltages; two would be required for the oxygen. [See also Abstract 1042 (1932).] AUTHORS.

2212. Electrolytic Overvoltage of Metals. T. Erdey-Grûz and M. Volmer. *Zeits. f. phys. Chem.* 157. *Abt. A.* 3–4. *pp.* 165–181, *Nov.*, 1931.—The characteristics of the electrodeposition of metals are considered from the various theoretically possible alternatives. It is shown that the discharge of the metallic ions is the slowest change while the arrangement of the discharged ions in the space lattice of the crystal is a rapid change. The velocity of the deposition is determined by the crystal growth, the discharge of the ions taking place where entry into the lattice can be effected without any marked retardation. By the aid of current-voltage curves and by kinematographic photographs of the growing crystals it is shown that the layer-by-layer growth of the nucleus determines the velocity of deposition in the case of Zn, Cd, Ni, Pb, Bi, Cu and Ag. F. J. B.

2213. Anodic Oxidation of Cobalt and Nickel Dichlorides. C. Schall. *Zeits. f. Elektrochem.* 38. *pp.* 27–32, *Jan.*, 1932.—The paper forms an addition to a previous publication [see Abstract 423 (1930)] on the production of cobalt and nickel triacetates by electrolysis. The production of the higher chlorides of nickel and cobalt is studied. It is found that, in the cold, cobalt dichloride in alcohol or alcoholic HCl solution, passes into the green trichloride. Formation of the trichloride takes place by the action of ethyl hypochlorite, produced by the reaction between chlorine and alcohol, in the presence of HCl. Double salts or addition compounds are formed with cæsium chloride and with pyridine. F. J. B.

2214. Theory of Electrolytic Valve Action. W. J. Müller. *Zeits. f. Physik*, 73. 7–8. *pp.* 560–564, *Dec.* 30, 1931.—In conjunction with Konopicky [see Abstract 2050 (1930)], the author has described experiments which led to the conclusion that Güntherschulze's earlier theory of electrolytic valve action could not be correct. It was shown that the solid layer of aluminium hydroxide is the seat of both the resistance and the capacity, so that the capacity cannot be due to a layer of oxygen. Güntherschulze and Betz [see Abstract 2897 (1931)] now confirm views of the author, who, in the present paper, discusses the matter further with the view of giving a clear exposition of the subject. Reply by **A. Güntherschulze,** *ibid.*, 75. 1–2. pp. 143–144, March 17, 1932. T. H. P.

2215. Characteristic Curves of the Aluminium Rectifying Cell. L. L. Barnes. *Phil. Mag.* 13. *pp.* 76–81, *Jan.*, 1932.—Characteristic curves of a rectifying cell consisting of Al and Pb electrodes in a solution of sodium borate are obtained, the cell being of a type used in charging storage batteries from an a.c. supply. The area of the Al electrode affects the rectifying properties. For small rectified currents this area should be kept small, while for larger outputs the area should be greater. The area of the Pb electrode only affects the ohmic resistance of the cell. The resistance from Al to Pb, at an applied p.d. of 100 volts, is about 150,000 ohms. A slight rise in the temperature of the cell appears beneficial, but a further rise reduces its power of rectification. N. D.